

TEST REPORT

Report Number: 102938966MIN-001

Project Number: G102938966

Testing performed on the
738Zplus

FCC ID: CCKPC0137R2

IC: 5251A-PC0137R2

to

47 CFR, Part 15. 249:2017

RSS- 210, Issue 9, 2016

RSS-Gen, Issue 4, 2014

47 CFR, Part 15:2017, §15.107 and §15.109, Class B / ICES-003, Issue 6:2016

For

Digital Monitoring Products

Test Performed by:
Intertek Testing Services NA, Inc.
7250 Hudson Blvd., Suite 100
Oakdale, MN 55128 USA

Test Authorized by:
Digital Monitoring Products
2500 N Partnership Blvd.
Springfield, MO 65803-8877 USA

Prepared by: Uri Spector
Uri Spector

Reviewed by: Norman Shpilsher
Norman Shpilsher

Date of issue: March 6, 2017

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.



TABLE OF CONTENTS

1.0 GENERAL DESCRIPTION.....3

1.1 Product Description; Test Facility 4

1.3 Environmental conditions..... 5

1.4 Measurement uncertainty 6

1.5 Field Strength Calculation..... 6

2.0 TEST SUMMARY..... 7

3.0 TEST CONDITIONS AND RESULTS..... 8

3.1 Field strength of fundamental 8

3.2 Field strength of harmonics and spurious emissions 10

3.2.1 Average correction factor calculation..... 15

3.3 Bandwidth of Emissions..... 17

3.4 Transmitter power line conducted emissions 20

3.5 Receiver/digital device radiated emissions..... 23

3.6 Digital device conducted emissions..... 28

4.0 TEST EQUIPMENT..... 31

5.0 REVISION HISTORY..... 32

1.0 GENERAL DESCRIPTION

Model:	738Zplus
Type of EUT:	Z-Wave interface module
Intertek Sample ID:	MN1702241314-007
FCC ID:	CCKPC0137R2
IC:	5251A-PC0137R2
Related Submittal(s) Grants:	None
Company:	Digital Monitoring Products
Customer:	James Wilson
Address:	2500 N Partnership Blvd. Springfield, MO 65803-8877 USA
Phone:	(800) 641-4282
E-mail:	jwilson@dmp.com
Test Standards:	☒ 47 CFR, Part 15:2017, §15.249 ☒ RSS-210, Issue 9, 2016 ☒ RSS-Gen, Issue 4, 2014 ☒ 47 CFR, Part 15:2017, §15.107 and §15.109, Class B, test method: ANSI C63.4-2014 ☒ ICES-003, Issue 6:2016 ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	February 24, 2017
Test Work Started:	March 1, 2017
Test Work Completed:	March 3, 2017
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good

1.1 Product Description; Test Facility

Product Description:	Z-Wave Radio
Operating Frequency	908.46 MHz
Modulation:	FSK
Emission Designator:	276KF1D
Antenna(s) Info:	Antenna Type: Integral trace
Antenna Installation:	☐ User ☒ Professional ☐ Factory
Transmitter Power Configuration:	☐ Internal battery ☒ External power source (AC Adapter) ☒ 100-240VAC ☐ 230VAC ☐ 400VAC ☐ VDC ☐ Other: 0.2 Amp. ☒ 50Hz ☒ 60Hz
Special Test Arrangement:	None
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2013

1.2 EUT Configuration

The equipment under test was operated during the measurement under the following conditions:

- ☒ - Standby
- ☒ - Continuous modulated
- ☒ - Continuous un-modulated
- ☐ - Test program (customer specific)
- ☒ - See below

Operating modes of the EUT:

No.	Description
1	Samples wired to provide continuous transmitting mode or receiving/standby mode.

Cables:

No.	Type	Length	Designation	Note
1	2-wire DC power cable	6ft.	DC side connecting the board and AC adapter	

Support equipment/Services:

No.	Item	Description
1	R & S SMT 03	Signal Generator used to activate receiver

1.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

☒ Normal

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

1.4 Measurement uncertainty

The expanded uncertainty ($k = 2$) for radiated emissions from 30 to 1000 MHz has been determined to be: ± 4 dB at 10m and ± 5.4 dB at 3m

The expanded uncertainty ($k = 2$) for radiated emissions above 1GHz has been determined to be: ± 6.4 dB at 3m

The expanded uncertainty ($k = 2$) for conducted emissions from 150 kHz to 30 MHz has been determined to be: ± 2.6 dB

1.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dB(μ V/m)

RA = Receiver Amplitude in dB(μ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB(m^{-1})

AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(μ V) is obtained. The antenna factor of 7.4 dB(m^{-1}) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(μ V/m).

$$RA = 48.1 \text{ dB}(\mu V)$$

$$AF = 7.4 \text{ dB}(m^{-1})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dB}$$

$$FS = RA + AF + CF - AG$$

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB}(\mu V/m)$$

General notes:

2.0 TEST SUMMARY

Referring to the performance criteria and the operating mode during the tests specified in this report, the equipment complies with the requirements according to the following standards.

TEST SPECIFICATION	TEST PARAMETERS	RESULT
15.249(a) / RSS-210 A2.9(a)	Field strength of fundamental	Pass
15.249(a) / RSS-210 A2.9(a)	Field strength of harmonics	Pass
15.249(d) / RSS-210 A2.9(b)	Field strength of spurious emissions	Pass
15.215(c) / RSS- Gen 4.6.1	Bandwidth of the emission	Pass
15.207/RSS-Gen 7.2.2	Transmitter Power Line conducted emissions	Pass
15.109/ICES-003	Receiver/digital device radiated emissions	Pass
15.107/ ICES-003	Digital device conducted emissions	Pass

3.0 TEST CONDITIONS AND RESULTS

3.1 Field strength of fundamental

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

Max. Emissions margin at fundamental: 5.8dB below the limits

Notes: The EUT was tested for worst case emissions in Z axis configuration.

Date:	March 1, 2017	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC 15.249(a) / RSS-210 A2.9	
Test Point:	Enclosure with antenna	
Operation mode:	See page 5	
Environmental Conditions:	22.5°C; 43%(RH); 96kPa	
Equipment Verification:	☒	
Note:	None	

Table 3.1.1

Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBμV	AVG Value C.F. (dB)	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)									
908.46	V	127	22.0	2.6	0.0	71.0	0.0	95.6	114.0	-18.4	Pk
908.46	H	129	22.0	2.6	0.0	74.3	0.0	98.9	114.0	-15.1	Pk
908.46	V	127	22.0	2.6	0.0	71.0	10.7	84.9	94.0	-9.1	Avg
908.46	H	129	22.0	2.6	0.0	74.3	10.7	88.2	94.0	-5.8	Avg



3.2 Field strength of harmonics and spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Frequency range of measurements: 30MHz-10GHz

Test result: Pass

Max. margin of harmonics and spurious emissions: 5.7dB below the limits

Max. margin of bandedge compliance: 8.3dB below the limits

Notes:

1. The EUT was tested for worst case emissions in Z axis configuration.
2. Fundamental transmitting frequency was excluded from the table.

Date:	March 1, 2017 and March 2, 2017	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC 15.249(a) and (d) / RSS-210 A2.9	
Test Point:	Enclosure with antenna	
Operation mode:	See page 5	
Environmental Conditions:	22.5°C; 43%(RH); 96.0kPa 23°C; 39%(RH); 96.7kPa	
Equipment Verification:	☒	
Note:	30MHz-1GHz	

Table 3.2.1

Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
30.654 MHz	V	13.0	20.0	33.0	40.0	-7.0
115.84 MHz	V	12.8	13.5	26.3	43.5	-17.2
31.614 MHz	H	13.5	19.4	33.0	40.0	-7.1
126.84 MHz	H	13.0	13.6	26.6	43.5	-16.9

Table 3.2.2

Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBμV	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)								
Bandedge Compliance										
902.00	V	100	22.0	2.6	0.0	12.1	36.7	46.0	-9.3	Pk
902.00	H	100	22.0	2.6	0.0	11.5	36.1	46.0	-9.9	Pk
928.00	V	100	22.0	2.6	0.0	12.4	37.0	46.0	-9.0	Pk
928.00	H	100	22.0	2.6	0.0	13.1	37.7	46.0	-8.3	Pk

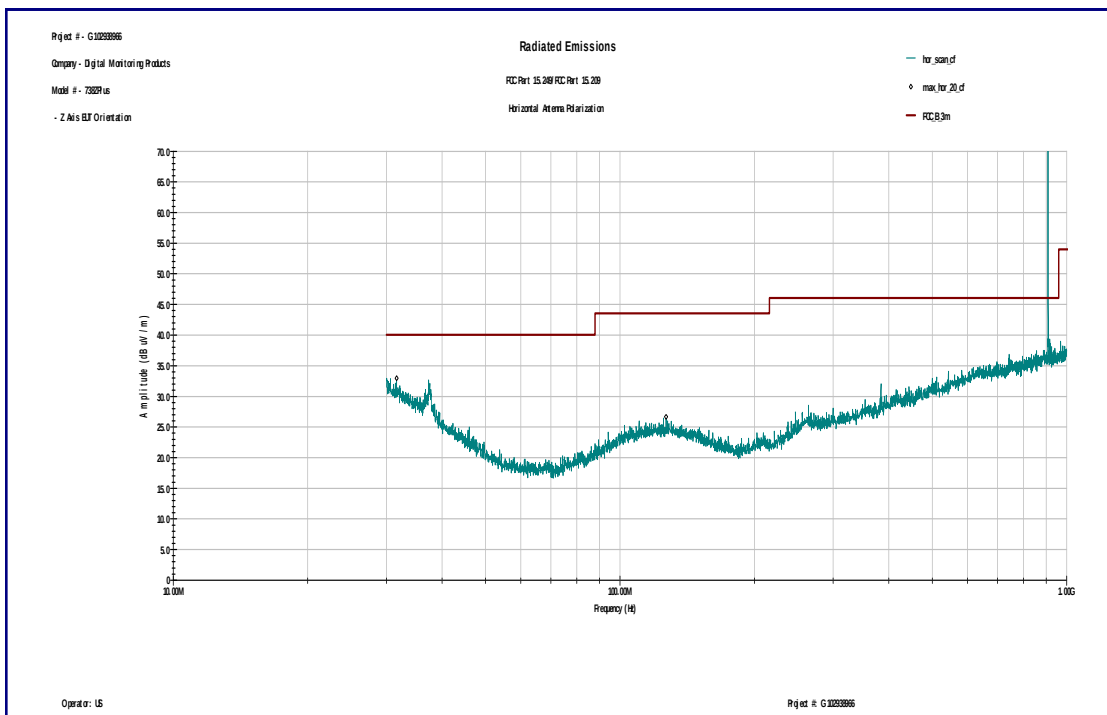
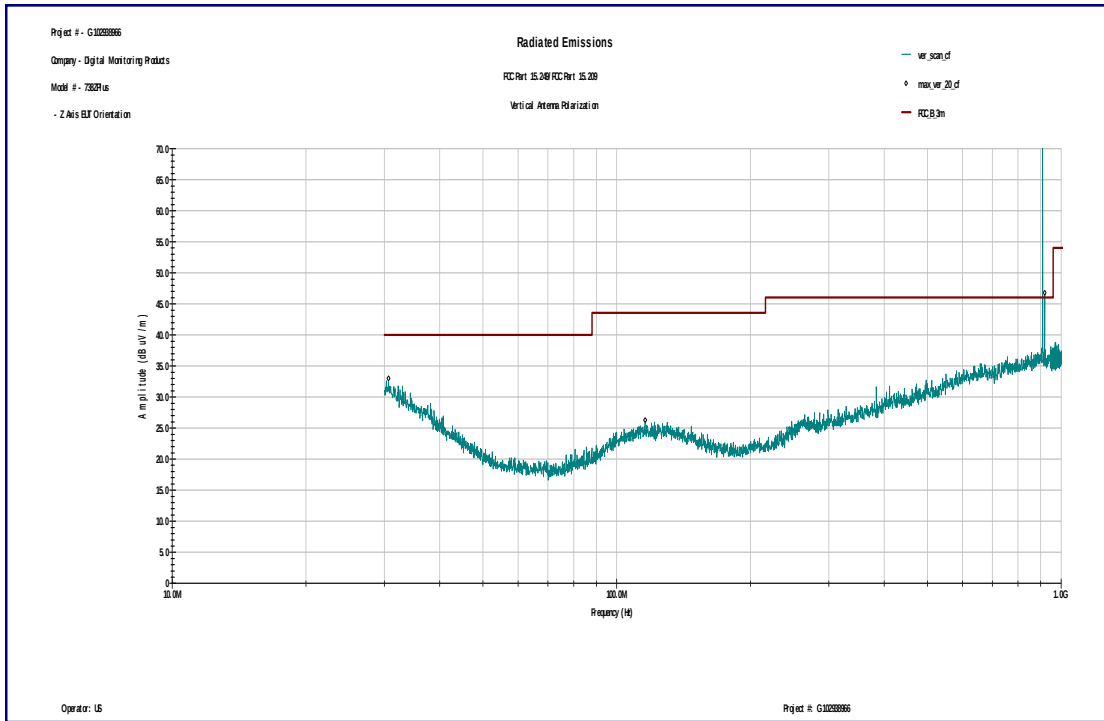
Date:	March 2, 2017	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC 15.249(a) and (d) / RSS-210 A2.9	
Test Point:	Enclosure with antenna	
Operation mode:	See page 5	
Environmental Conditions:	23°C; 39%(RH); 96.7kPa	
Equipment Verification:	☒	
Note:	1GHz-10GHz	

Table 3.2.3

Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
2.728 GHz	V	56.8	31.9	40.4	48.3	54.0	-5.7
4.546 GHz	V	45.9	36.6	39.4	43.1	54.0	-10.9
2.728 GHz	H	54.7	31.9	40.4	46.2	54.0	-7.8
4.546 GHz	H	45.9	36.6	39.4	43.1	54.0	-10.9

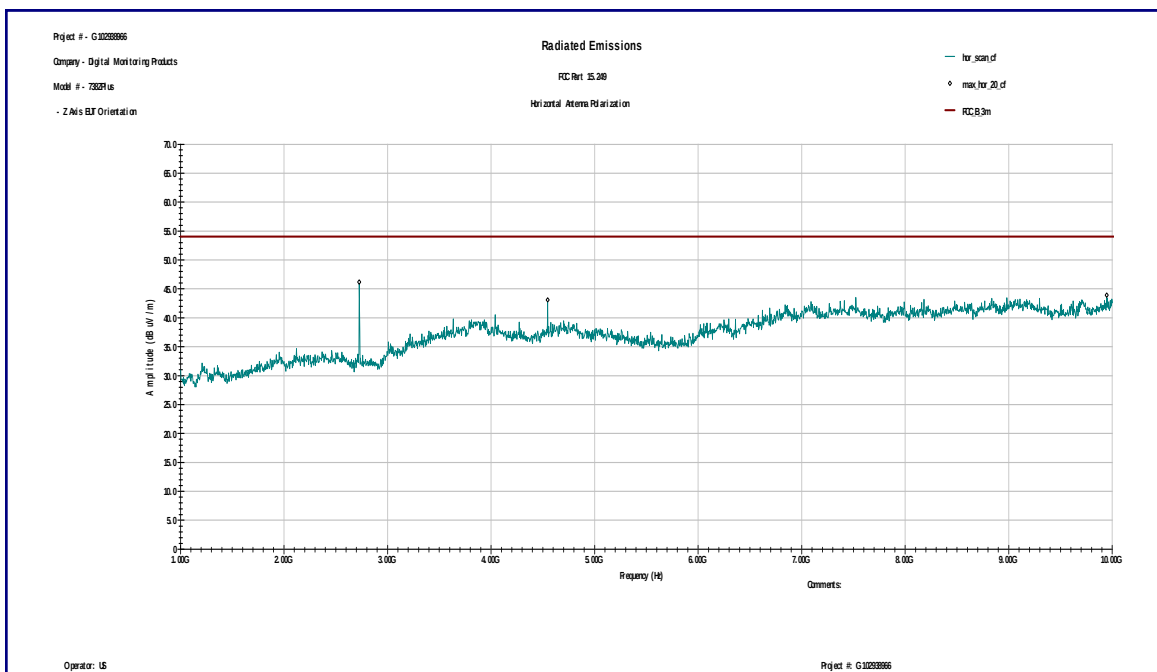
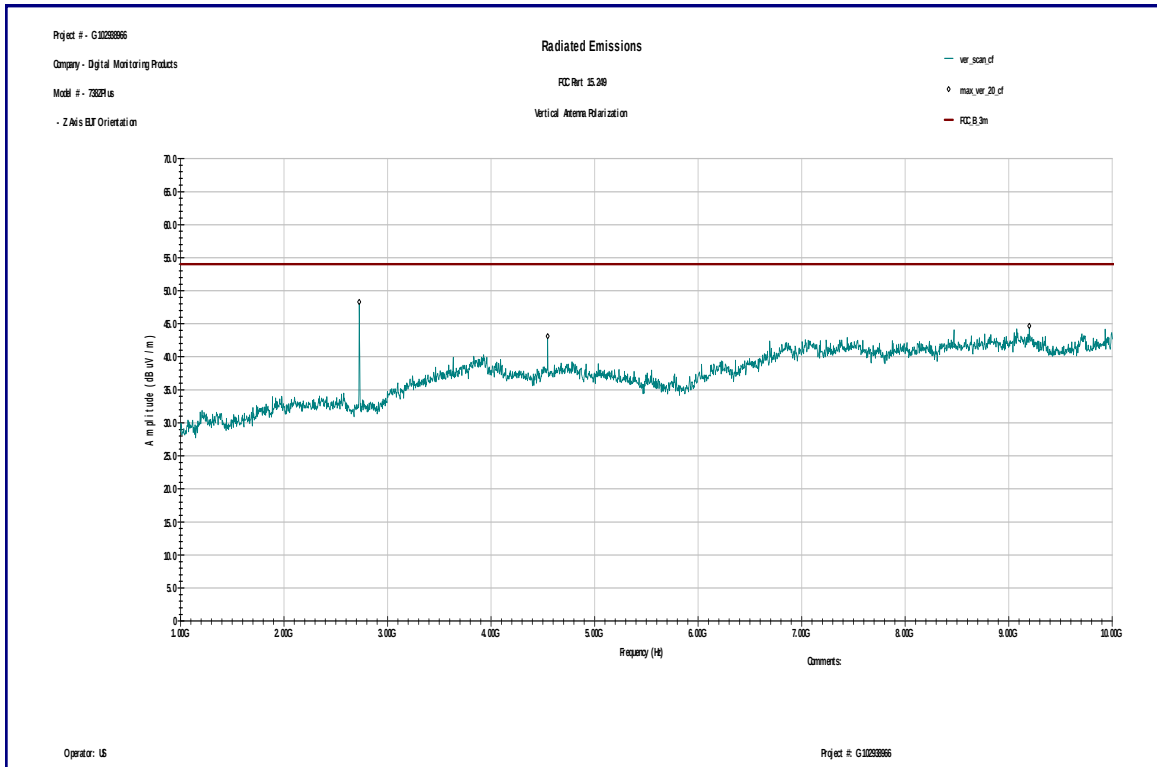


Graph 3.2.1 (Peak)





Graph 3.2.2 (Peak)



3.2.1 Average correction factor calculation

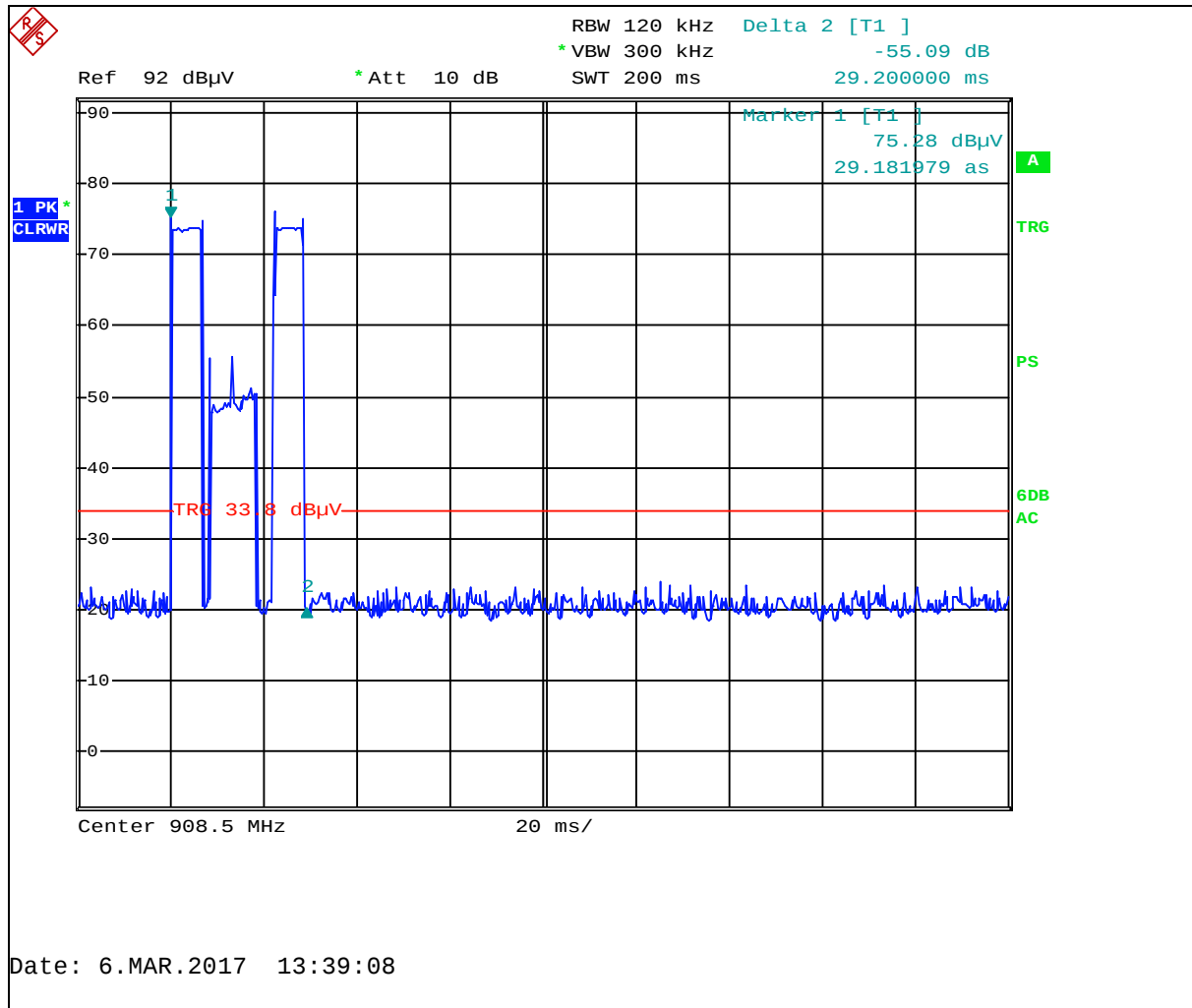
An Average correction factor is calculated by averaging one complete pulse train.

The pulse train exceeds 100ms. Therefore the measured field strength was determined during a 100ms interval
Time with field strength is in its maximum value (length of pulses) = 29.2ms (see Graph 3.2.3)

Average Correction Factor = $20\text{Log}(29.2\text{ms}/100\text{ms}) = -10.7\text{dB}$



Graph 3.2.3





3.3 Bandwidth of Emissions

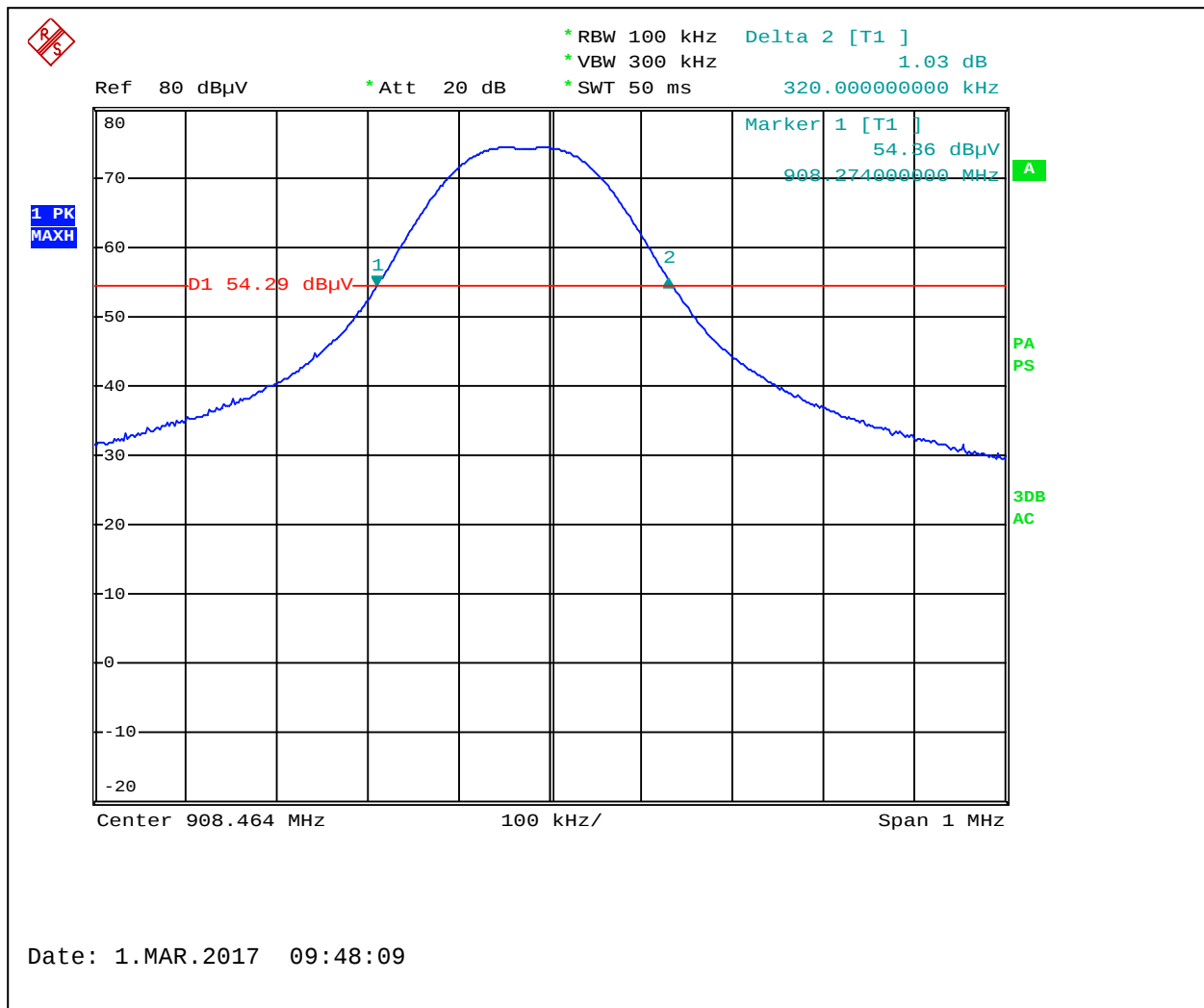
Center Frequency of operation MHz	Measured 20dB bandwidth kHz	Measured 99% bandwidth kHz
908.41	320	276

Graphs 3-3-1 and 3-3-2 are show bandwidth of emissions

Notes: The bandwidth of emissions is contained within the frequency band of operation

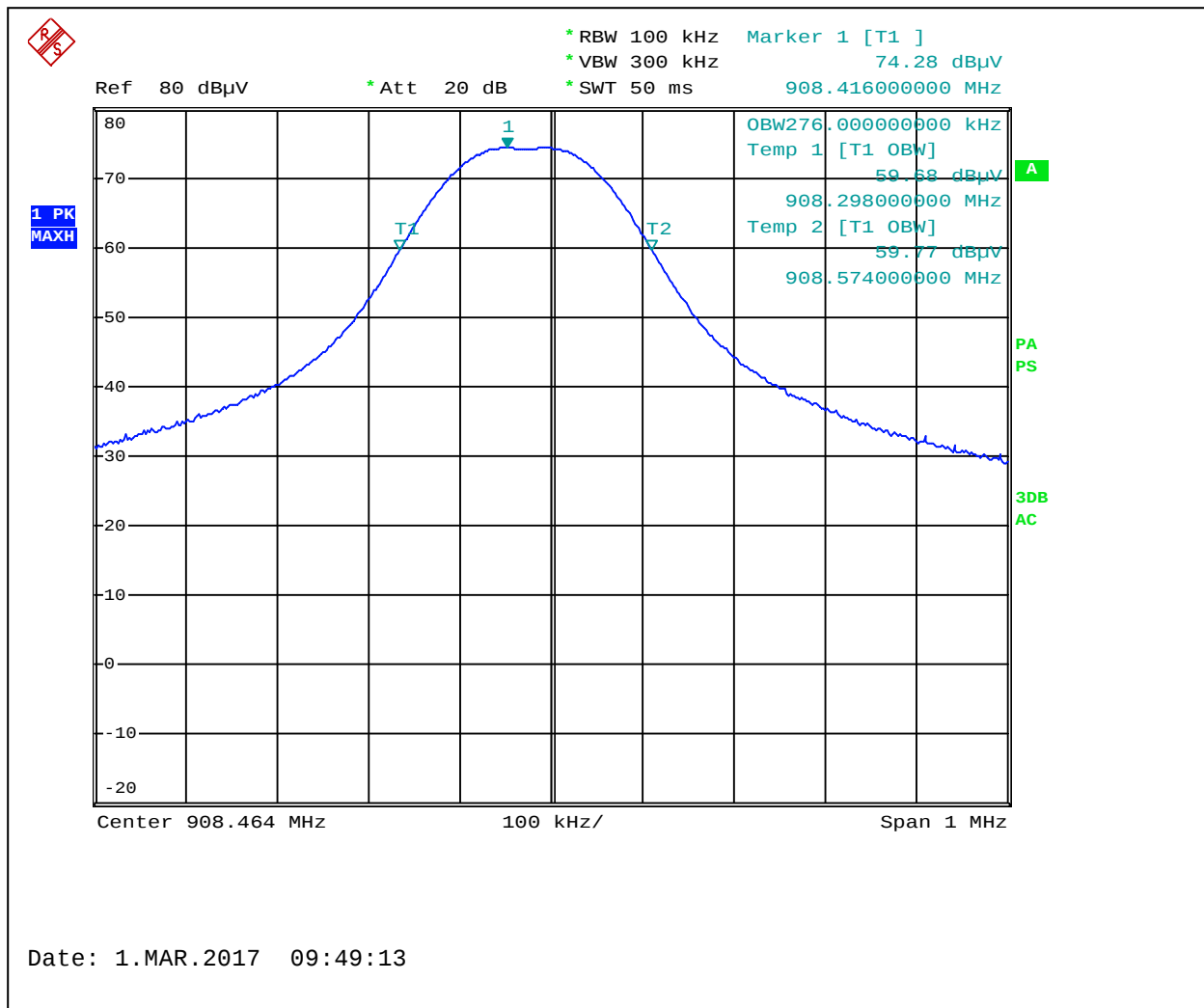


Graph 3.3.1





Graph 3.3.2



3.4 Transmitter power line conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: Pass

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 4.0dB below the limits

Notes: None

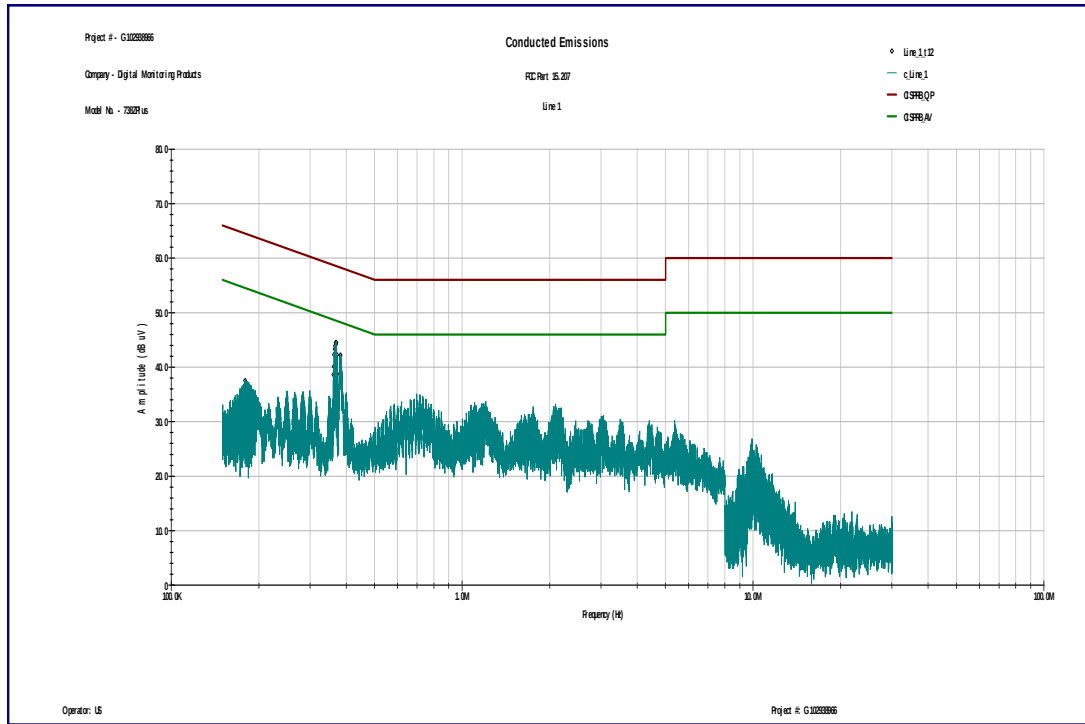
Date:	March 3, 2017	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC 15.207	
Test Point:	Power Line	
Operation mode:	See page 5	
Environmental Conditions:	23.1°C; 39.2%(RH); 96.8kPa	
Equipment Verification:	☒	
Note:	None	

Table 3.4.1

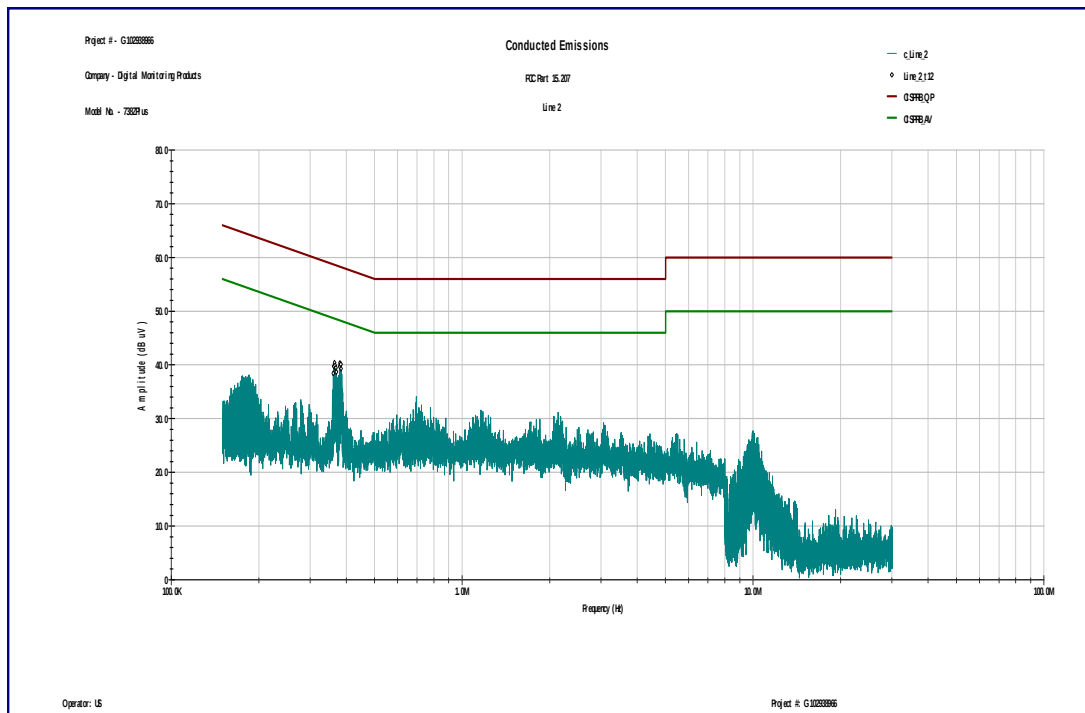
Line 1					
Frequency	Peak dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
179.6 KHz	37.5	64.5	54.5	-27.0	-17.0
367.17 KHz	44.5	58.6	48.6	-14.1	-4.1
369.81 KHz	44.5	58.5	48.5	-14.0	-4.0
371.05 KHz	42.2	58.5	48.5	-16.2	-6.2
372.13 KHz	38.8	58.5	48.5	-19.7	-9.7
381.86 KHz	42.2	58.2	48.2	-16.0	-6.0
Line 2					
Frequency	Peak dBμV	QP Limit dBmV	AVG Limit dBmV	QP Margin dB	AVG Margin dB
360.51 KHz	38.4	58.7	48.7	-20.3	-10.3
364.38 KHz	40.4	58.6	48.6	-18.2	-8.2
379.51 KHz	39.7	58.3	48.3	-18.6	-8.6
380.1 KHz	40.3	58.3	48.3	-17.9	-7.9
382.64 KHz	40.1	58.2	48.2	-18.1	-8.1
383.42 KHz	39.3	58.2	48.2	-18.9	-8.9

Graph 3.4.1

Line 1



Line 2



3.5 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoic Chamber

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

Frequency range: 30MHz-5000MHz

Max. Emissions margin: 7.6dB below the limits

Notes:

1. The EUT was tested for worst case emissions in Z axis configuration.
2. Signal generator transmitting frequency to activate receiver was excluded from the table

Date:	March 2, 2017	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC Part 15.109, Class B	
Test Point:	Enclosure	
Operation mode:	See page 5	
Environmental Conditions:	23°C; 39%(RH); 96.7kPa	
Equipment Verification:	☒	
Note:	30MHz-1GHz	

Table 3.5.1

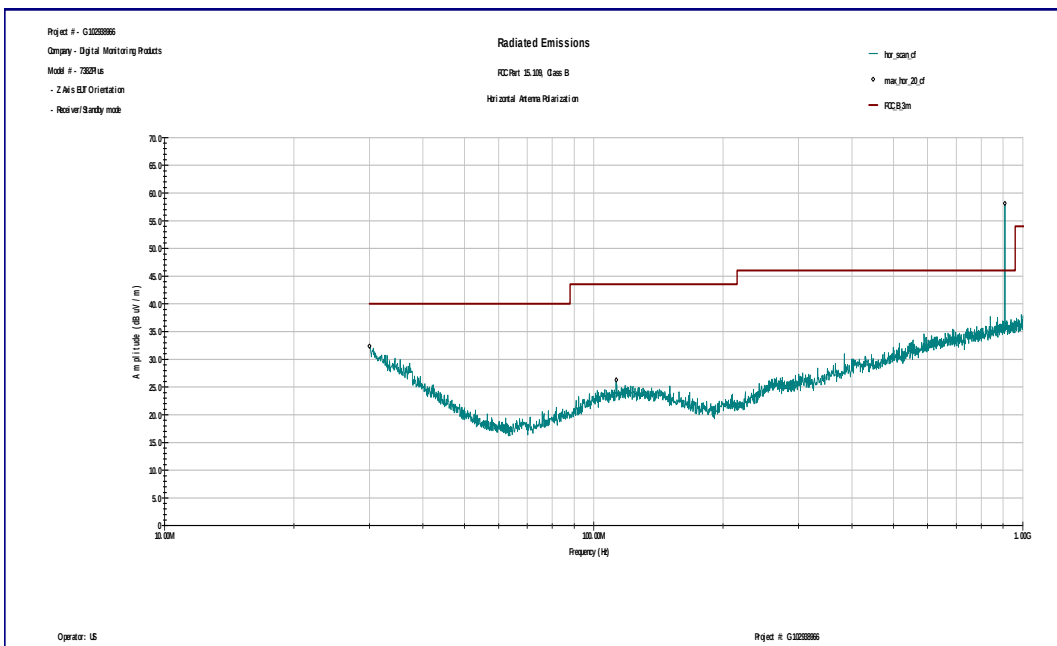
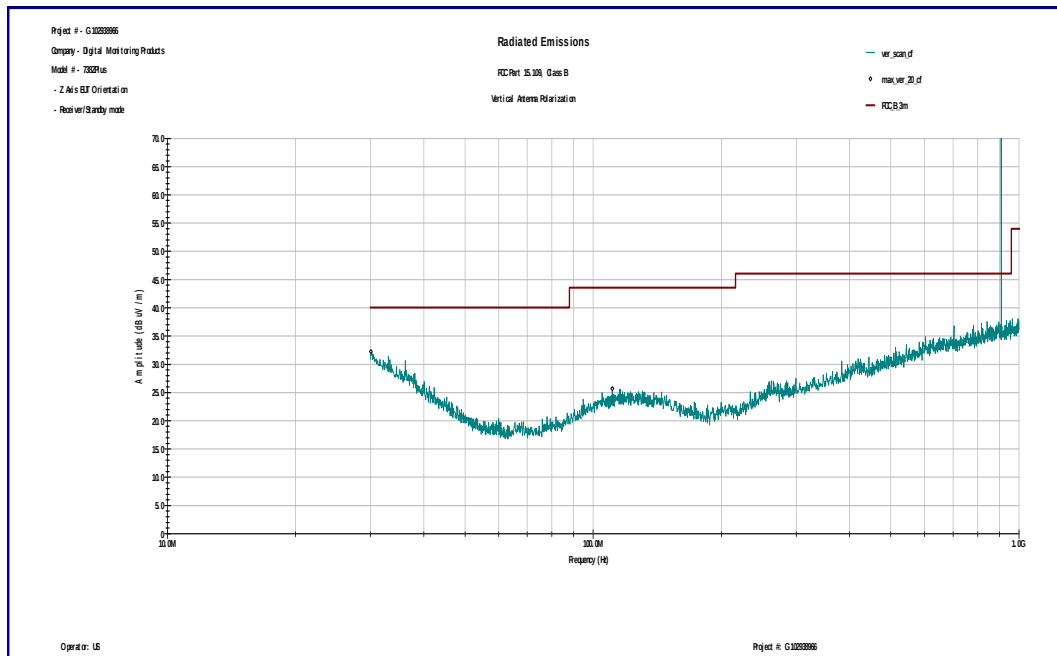
Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
30.069 MHz	V	11.9	20.4	32.2	40.0	-7.8
110.89 MHz	V	12.4	13.3	25.7	43.5	-17.9
30.0 MHz	H	12.0	20.4	32.4	40.0	-7.6
112.83 MHz	H	12.9	13.4	26.3	43.5	-17.2

Date:	March 2, 2017	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC Part 15.109, Class B	
Test Point:	Enclosure	
Operation mode:	See page 5	
Environmental Conditions:	23°C; 39%(RH); 96.7kPa	
Equipment Verification:	☒	
Note:	1GHz-5GHz	

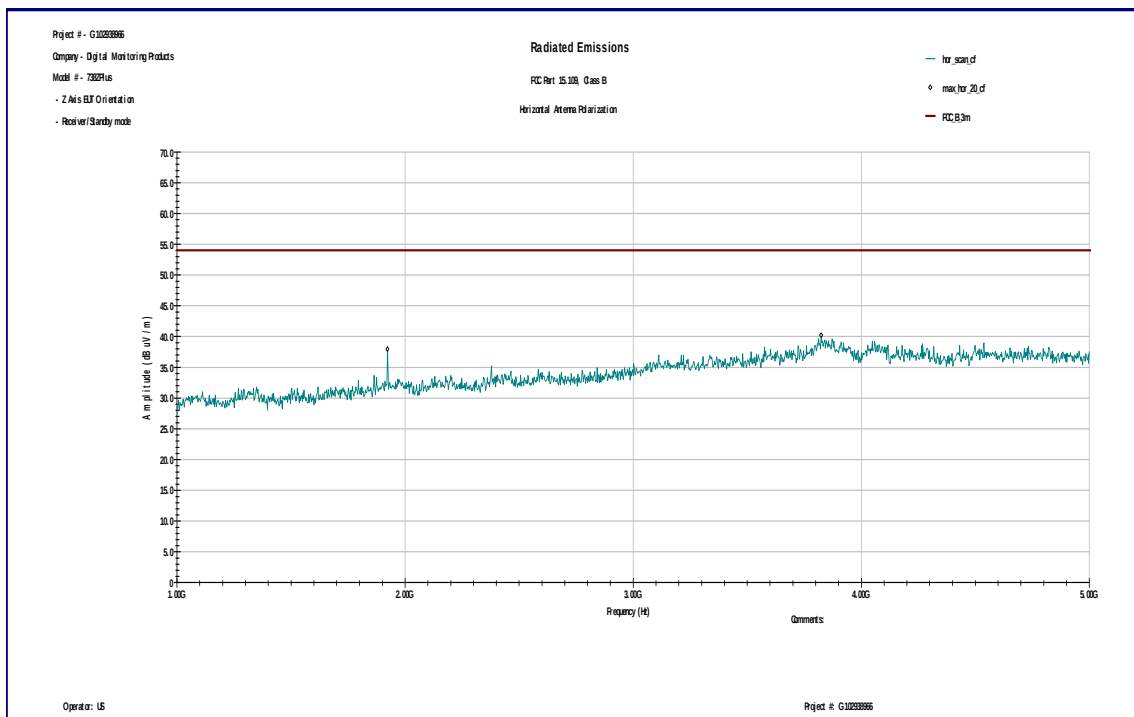
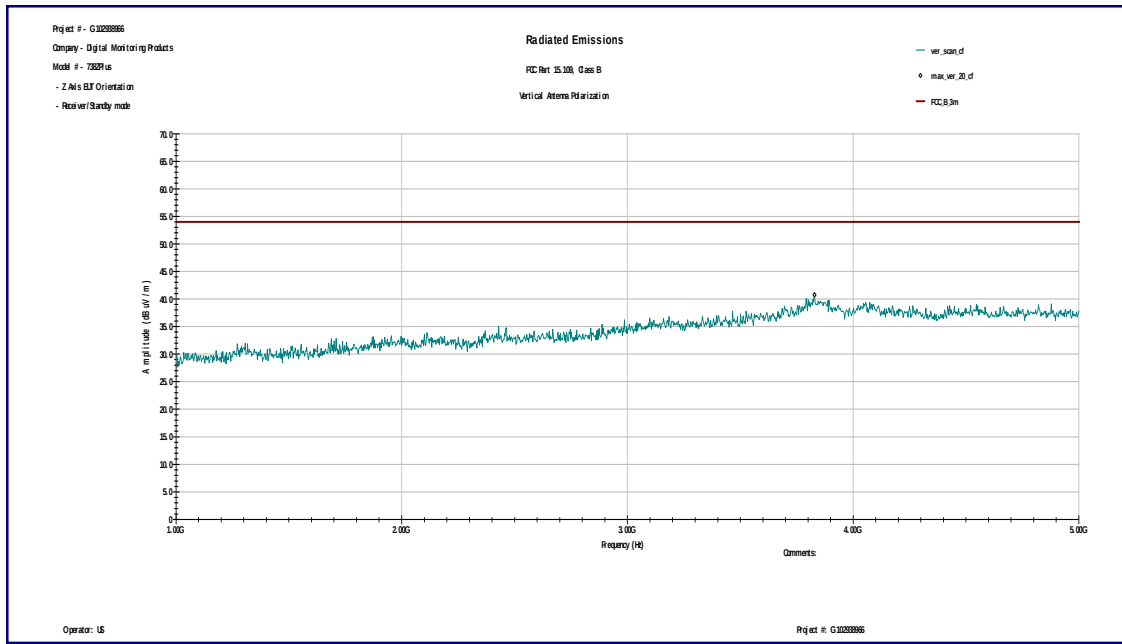
Table 3.5.2

Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
3.8293 GHz	V	44.2	36.6	40.1	40.7	54.0	-13.2
1.9227 GHz	H	49.0	30.0	41.0	37.9	54.0	-16.0
3.824 GHz	H	43.8	36.5	40.1	40.2	54.0	-13.8

Graph 3.5.1



Graph 3.5.2





3.6 Digital device conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 5.4dB below the limits

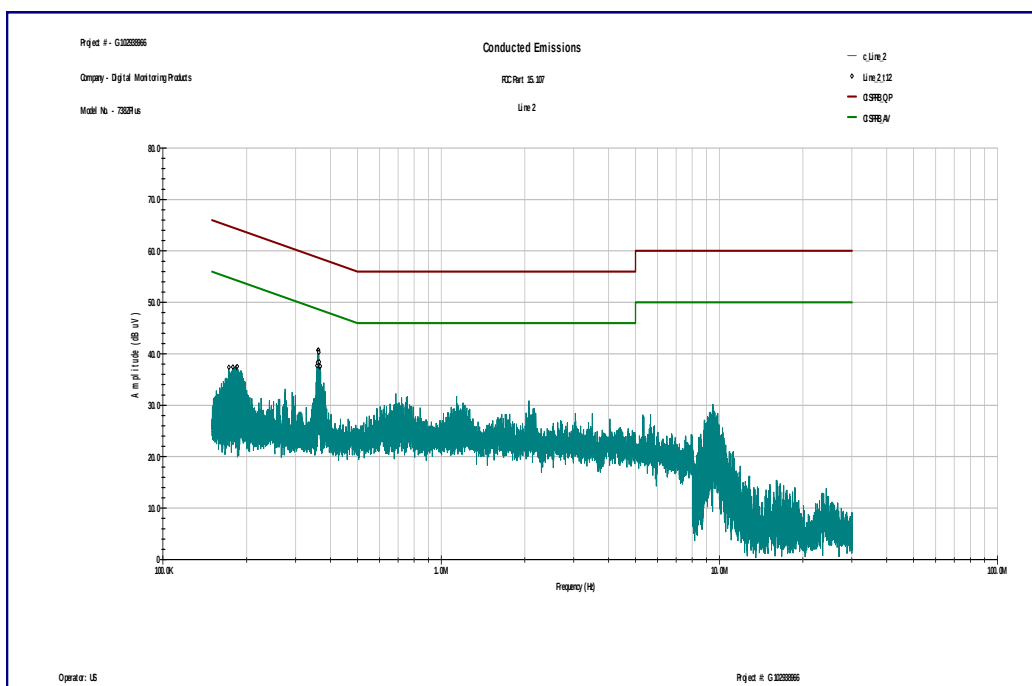
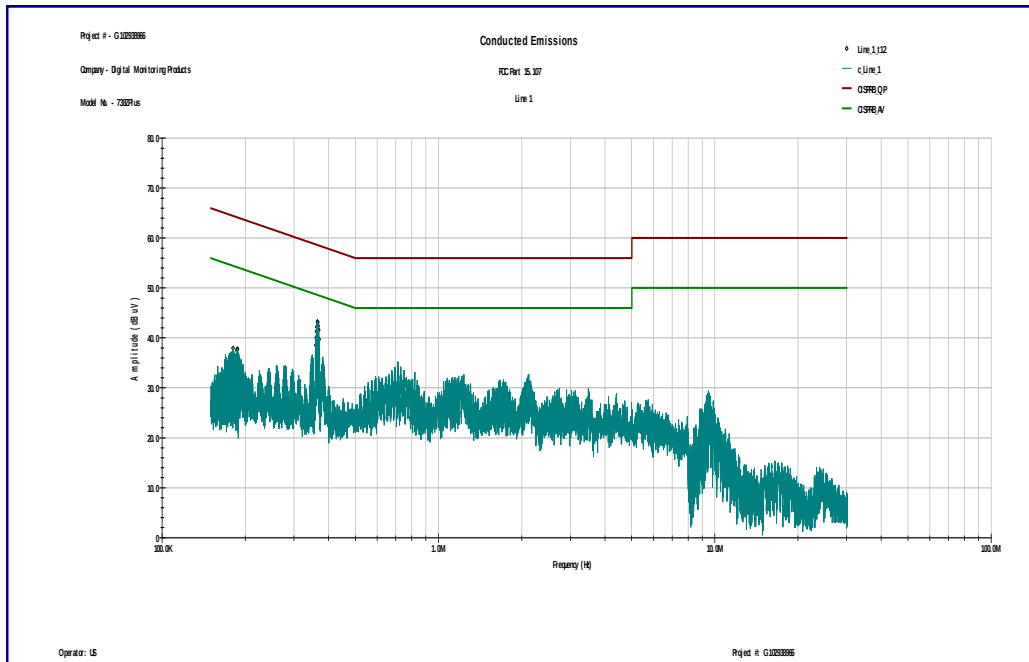
Notes: None

Date:	March 3, 2017	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC Part 15.107, Class B	
Test Point:	Power Line	
Operation mode:	See page 5	
Environmental Conditions:	23.1°C; 39.2%(RH); 96.8kPa	
Equipment Verification:	☒	
Note:	None	

Table 3.6.1

Line 1					
Frequency	Peak dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
180.37 KHz	37.9	64.5	54.5	-26.5	-16.5
187.44 KHz	37.8	64.2	54.2	-26.3	-16.3
361.9 KHz	41.3	58.7	48.7	-17.4	-7.4
364.38 KHz	43.2	58.6	48.6	-15.4	-5.4
365.62 KHz	43.1	58.6	48.6	-15.5	-5.5
367.02 KHz	42.4	58.6	48.6	-16.2	-6.2
Line 2					
Frequency	Peak dBμV	QP Limit dBmV	AVG Limit dBmV	QP Margin dB	AVG Margin dB
172.6 KHz	37.4	64.8	54.8	-27.5	-17.5
178.43 KHz	37.5	64.6	54.6	-27.1	-17.1
184.95 KHz	37.5	64.3	54.3	-26.7	-16.7
359.42 KHz	38.3	58.7	48.7	-20.4	-10.4
362.06 KHz	40.8	58.7	48.7	-17.9	-7.9
363.45 KHz	40.3	58.7	48.7	-18.4	-8.4

Graph 3.6.1





4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	LAST CAL DATE	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	12559	01/26/2017	01/26/2018	☒
Spectrum Analyzer	R & S	ESCI	100358	12909	10/31/2016	10/31/2017	☒
Bicono-Log Antenna	Teseq	CBL6112D	32859	25289	10/03/2016	10/03/2017	☒
Horn Antenna	EMCO	3115	9507-4513	9936	07/12/2016	07/12/2017	☒
LISN	COM-Power	Li-215A	191970	172315	06/13/2016	06/13/2017	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	12/01/2016	12/01/2017	☒
High Pass Filter	Reactel Inc.	7HS-1G-S1	0223	15275	VBU	VBU	☒
System	Quantum Change	TILE! Instrument Control	Ver. 3.4.K.29	15259	VBU	VBU	☒



5.0 Revision History

REVISION LEVEL	DATE	REPORT NUMBER	PREPARED	REVIEWED	NOTES
0	03-06-2013	102938966MIN-001	US	NS	Original Issue