

EMC TEST REPORT



Standard(s):

47 CFR FCC Part 15.247
RSS 247, Issue 2, 2017

FCC ID: DGFPSD3100273
IC:458A-PSD3100273

Product: 3M™ DBI Sala Nano-Lok Connected Carabiner
Model(s): 2000037

Company Name:
3M Company

Address:
3M Center, Building 235
St. Paul, MN 55144-1000

Report Number: RE1906154-3
Report Issue Date: September 23, 2019

Report Prepared by:

Signature: 
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Tested by:
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**TABLE OF CONTENTS**

Item	Description	Page
1.0	Test Summary	3
1.1	Measurement Uncertainty	3
2.0	Equipment Description	4
2.1	Equipment Under Test	4
3.0	EUT Configuration	5
3.1	System Configuration	5
3.2	Input/Output Ports of EUT	5
3.3	Cables	5
3.4	Measurement Arrangements of EUT	5
3.5	Primary functions(s) of EUT	5
3.6	Exercising of EUT and Interfaces	5
4.0	Test Conditions and Results	6
4.1	Radiated Emissions in restricted band	6
4.2	Radiated Emissions in non-restricted band	14
5.0	Test Equipment	16
6.0	Revision History	16

1.0 Test Summary

Based on the results of our investigation, we have concluded the product tested **comply** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

	Test Description	Requirement – Test	Result	Comments
4.1	15.209/RSS Gen, 8.9	Radiated Emissions in restricted band	pass	See note
4.2	15.247(d)/RSS 247,5.5	Radiated Emissions in non-restricted band	pass	See note

Note:	Nordic Semiconductor nRF52832 transmitter verification when placed in another host (hereafter called “the carabiner”). There are no modifications or physical changes to the transmitter and the same type/gain of antenna is used.
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1.1 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements. The measurement uncertainty figures were calculated and correspond to a coverage factor of k=2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Radiated emissions 30MHz to 1000MHz	4.9 dB
Radiated emissions 1GHz to 18GHz	4.6 dB
Conducted emissions 150KHz to 30MHz (AMN)	2.7 dB
Conducted emissions 150KHz to 30MHz (AAN)	1.92 dB



2.0 Equipment Description

2.1	Equipment Under Test			
Description:	3M Active Safety Connected Bluetooth Carabiner			
Model(s):	2000037			
Serial number:	N/A			
Contact:	Scott Brigham			
Phone:	651 737 2827			
3M Division:	Personal Safety			
Modifications and Special Measures:	none			
Frequency Range:	2402.0-2480.0 MHz			
Channel No.:	39			
Modulation Type:	GFSK			
Output Power EIRP:	-2.4dBm (0.6mW)			
Antenna Type:	Internal Chip Antenna			
Antenna Gain:	1.1 dBi			
Test Deviations or Exclusions	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No		
Rated Power:	Voltage:	<input type="checkbox"/> 120VAC	<input type="checkbox"/> 230VAC	<input checked="" type="checkbox"/> 3VDC
	Phase:	<input type="checkbox"/> 1ph	<input type="checkbox"/> 3ph	<input checked="" type="checkbox"/> Battery
	Frequency:	<input type="checkbox"/> 50Hz	<input type="checkbox"/> 60Hz	
	Current:			
Test Dates:	09/12-09/16/2019			
Received Date:	09/12/2019			
Received Conditions:	<input type="checkbox"/> Poor	<input checked="" type="checkbox"/> Good		
	<input checked="" type="checkbox"/> Prototype	<input type="checkbox"/> Production		

3.0 EUT Configuration

3.1 System Configuration

No.	Product Type	Manufacturer	Model	Comments
1	Carabiner PCB	3M	2000037	
2				

3.2 Input/Output Ports of EUT

No.	Description	Type	Comments
1			
2			

3.3 Cables

No.	Description	Type	Length	Shielding	Comments
1					
2					

3.4 Measurement Arrangements of EUT

	Intended Operational Arrangement(s)	Comments
<input checked="" type="checkbox"/>	Table-top only	
<input type="checkbox"/>	Floor-standing only	
<input type="checkbox"/>	Floor-standing or table-top	
<input type="checkbox"/>	Other	

3.5 Primary function(s) of EUT

No.	List of Essential Functions
1	Transferring of various environmental and functional data via Bluetooth radio using 3M Active Safety Messaging Protocol.
2	

3.6 Exercising of EUT and Interfaces

No.	Mode of Operation
1	Transmitting at lowest (0), middle (19) and highest (39) channels of operation with unmodulated CW carrier
2	Device programming using Nordic Studio BT software for continues transmission of modulated carrier at maximum rated RF output power and Duty Cycle.



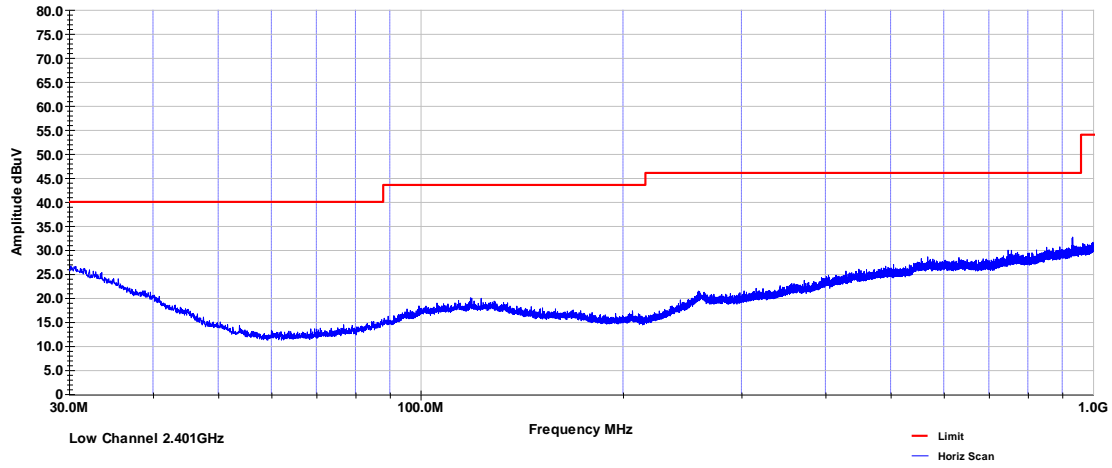
4.1	Radiated Emissions in restricted band				
Method:	Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4 standards. EUT was rotated through three orthogonal axes to determine which attitude (orientation) and arrangement produces the highest emission relative to the limit; the attitude and device arrangement that produces the highest emission relative to the limit was used in making final radiated emission measurements. Spurious Radiated emissions measurements were performed with external preamp and a high pass filter. Final measurements were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.				
Test Verification: <input checked="" type="checkbox"/>	Laboratory Ambient Temperature:		23°C		
	Relative Humidity:		55%		
	Atmospheric Pressure:		1011 mbars		
Reference Standard(s):	<input type="checkbox"/> ANSI C63.4:2014:2014		Measurement Distance		
	<input checked="" type="checkbox"/> ANSI C63.10:2013:2013				
	<input checked="" type="checkbox"/> FCC Part 15.247		<input checked="" type="checkbox"/> 3 Meters <input type="checkbox"/>		
	<input type="checkbox"/>				
Frequency Range:	<input checked="" type="checkbox"/> 30 MHz to 1 GHz				
	<input checked="" type="checkbox"/> 1 GHz to 25 GHz				
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 3VDC				
Test Personnel:	Keith Schwartz <i>KS</i>		Date: 09/14/2019		
Limits – 15.109, Class A					
Frequency (MHz)	Limit dB (µV/m)			Distance	Results
	Quasi-Peak	Average	Peak		
30 to 88	39			10	N/A
88 to 216	43.5			10	N/A
216 to 960	46.4			10	N/A
Above 960	49.5			10	N/A
Limits – 15.109, Class B and 15.209					
0.009-0.490		2400/F(KHz)	300	300	N/A
0.490-1.705	24000/F(KHz)		30	30	N/A
1.705-30	30		30	30	N/A
30 to 88	40			3	pass
88 to 216	43.5			3	pass
216 to 960	46			3	pass
Above 960		54		3	pass

Modifications:	
Note:	<p>For emission in the restricted bands, the limit of 15.209 was used.</p> <p>The lower limit applies at the transition frequency. An inverse proportionality factor of 20 dB per decade has been used to normalize the measured data to the specified distance for determining compliance.</p> <p>No radiated spurious emissions were detected above 18GHz.</p>



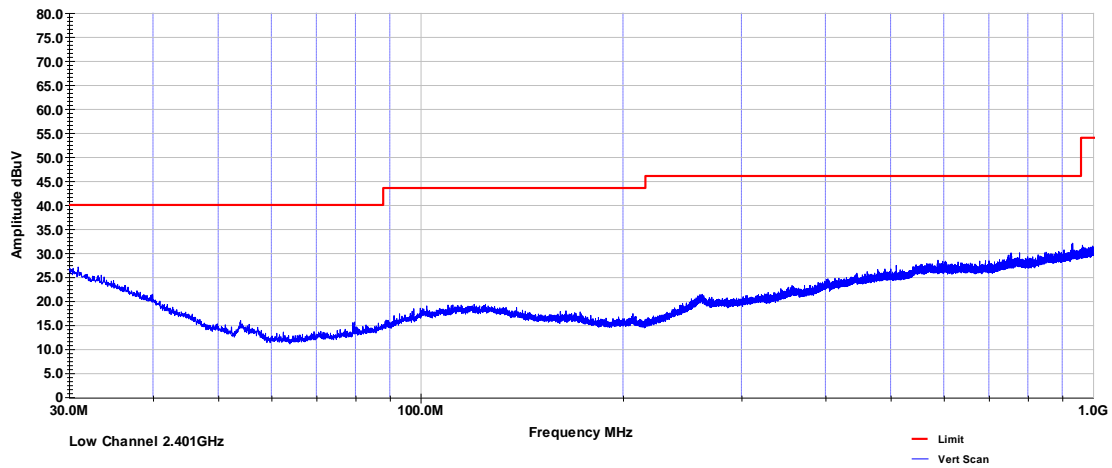
3M Company
Radiated Emissions Prescan
FCC Part 15, Class B, Horizontal

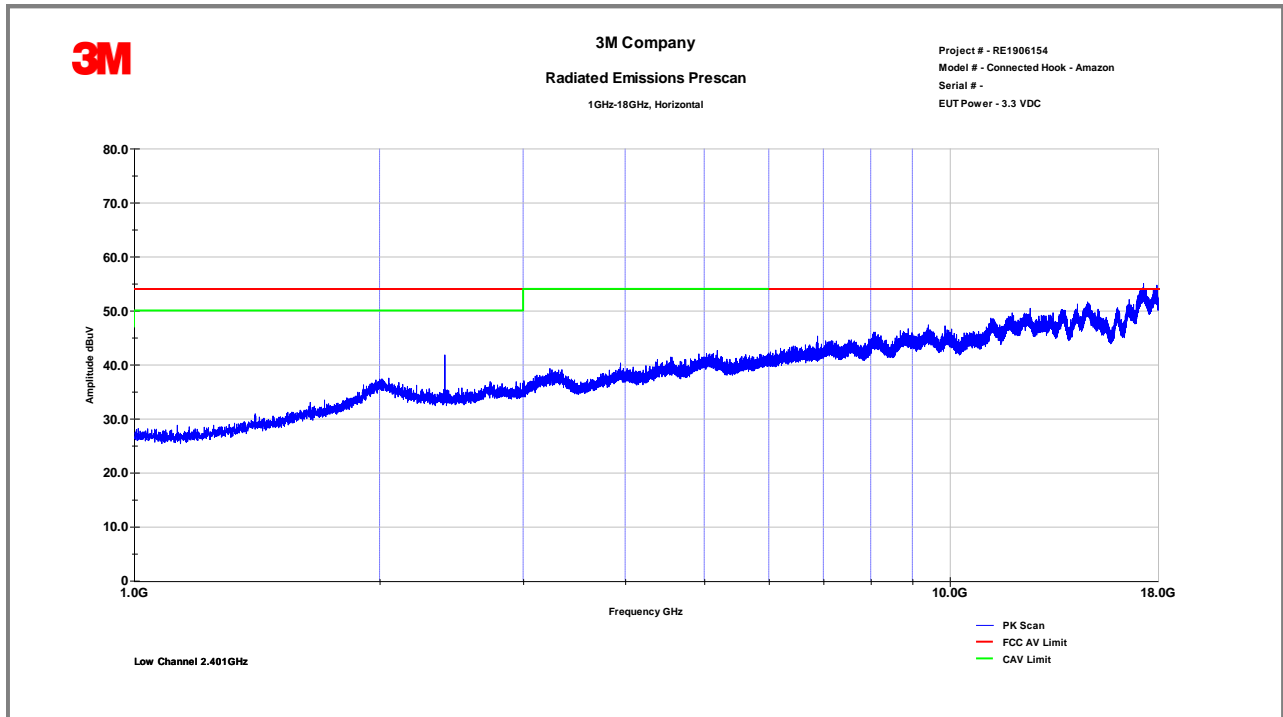
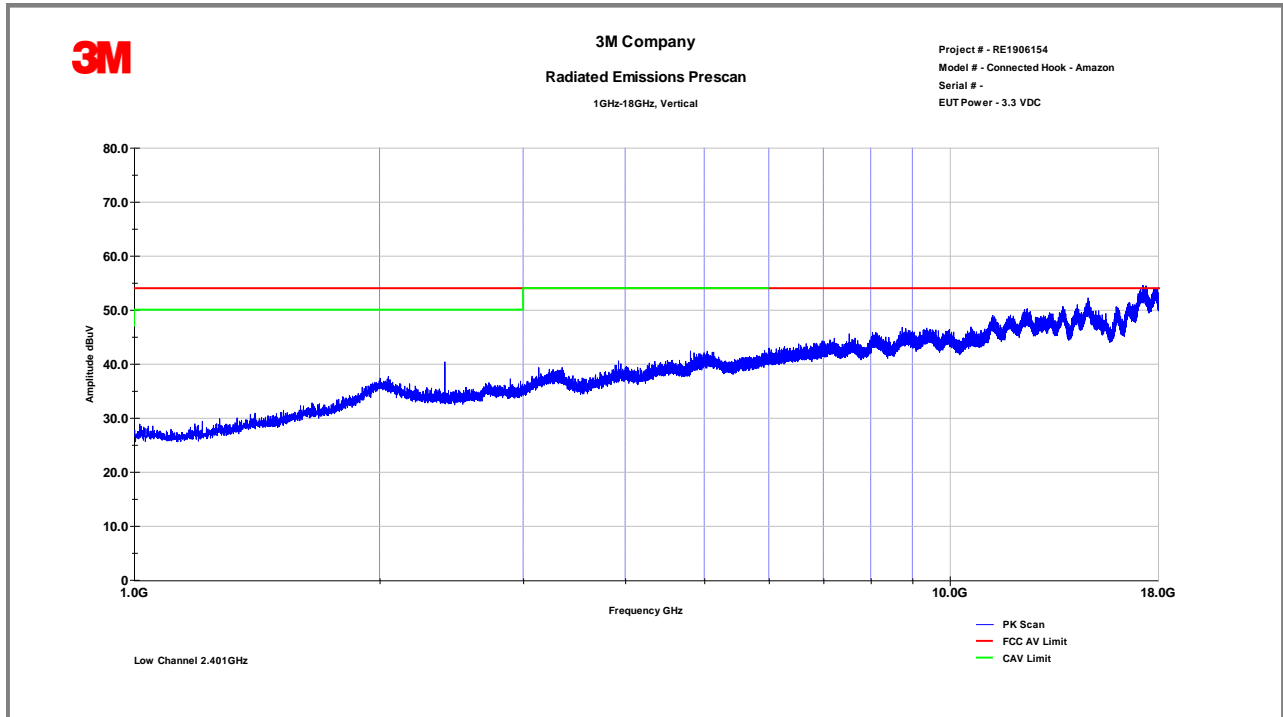
Project # - RE1906154
Model # - Connected Aluminum Carabiner 200003
Serial # -
EUT Power - 3.3 VDC



3M Company
Radiated Emissions Prescan
FCC Part 15, Class B, Vertical

Project # - RE1906154
Model # - Connected Aluminum Carabiner 200003
Serial # -
EUT Power - 3.3 VDC

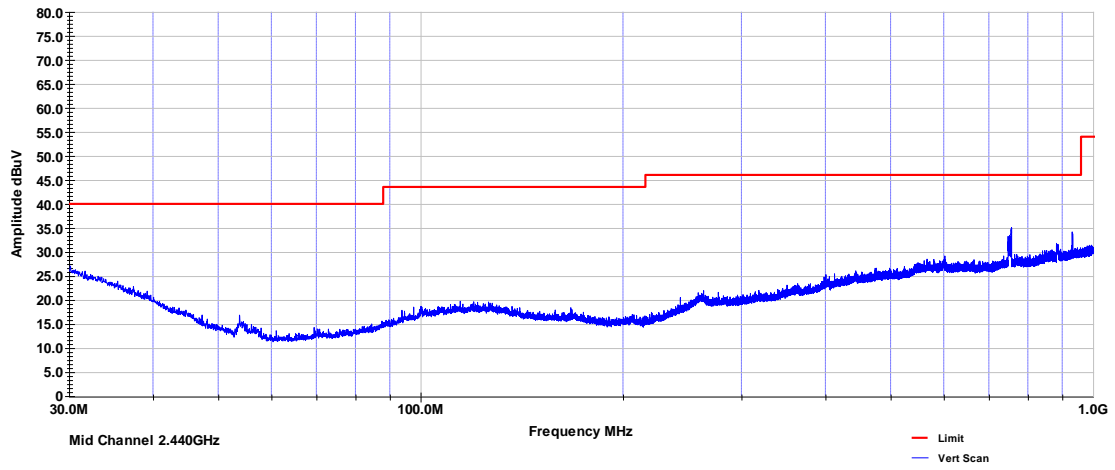






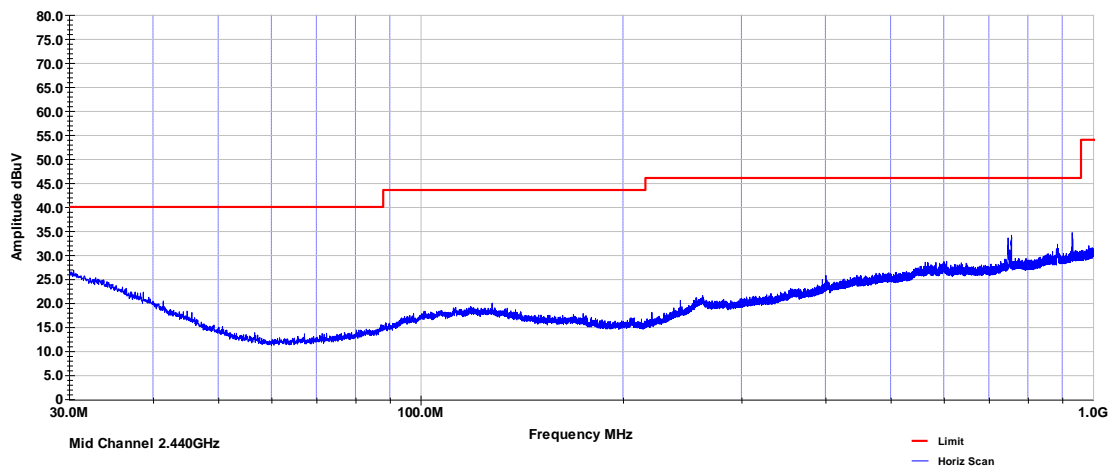
3M Company
Radiated Emissions Prescan
FCC Part 15, Class B, Vertical

Project # - RE1906154
Model # - Connected Aluminum Carabiner 200003
Serial # -
EUT Power - 3.3 VDC



3M Company
Radiated Emissions Prescan
FCC Part 15, Class B, Horizontal

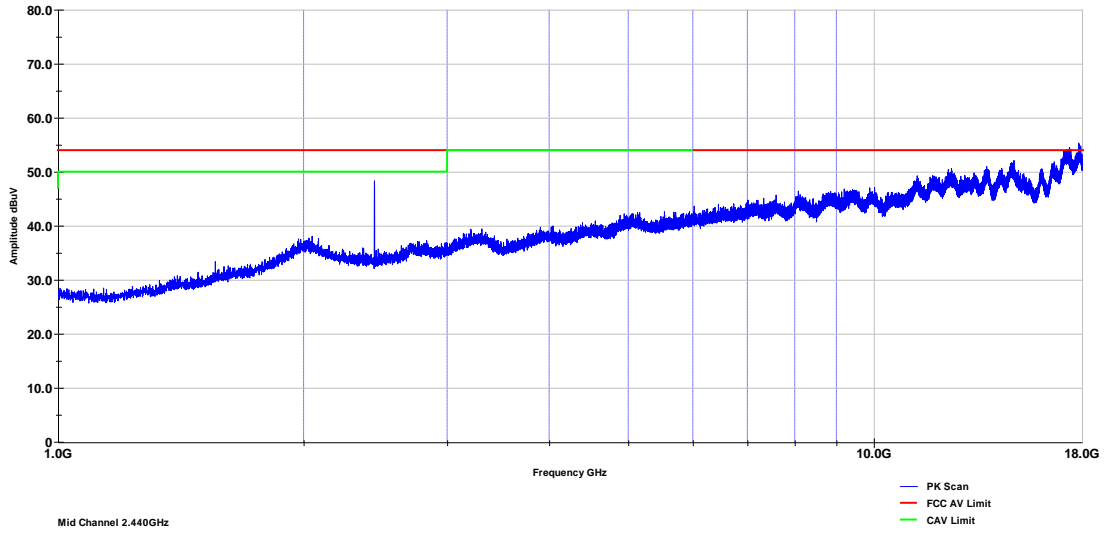
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Model # - Connected Aluminum Carabiner 200003
Serial # -
EUT Power - 3.3 VDC





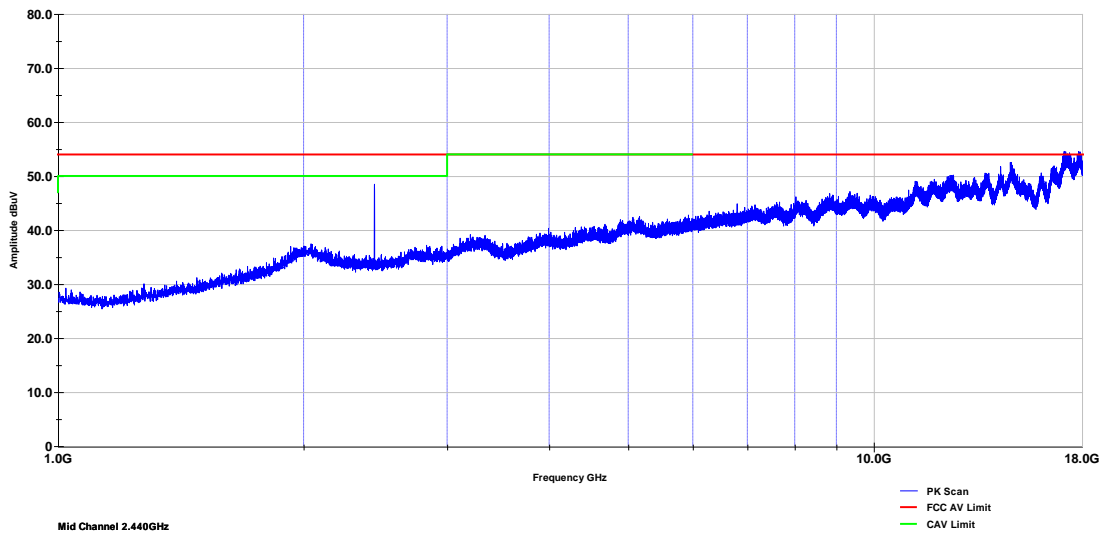
3M Company
Radiated Emissions Prescan
1GHz-18GHz, Vertical

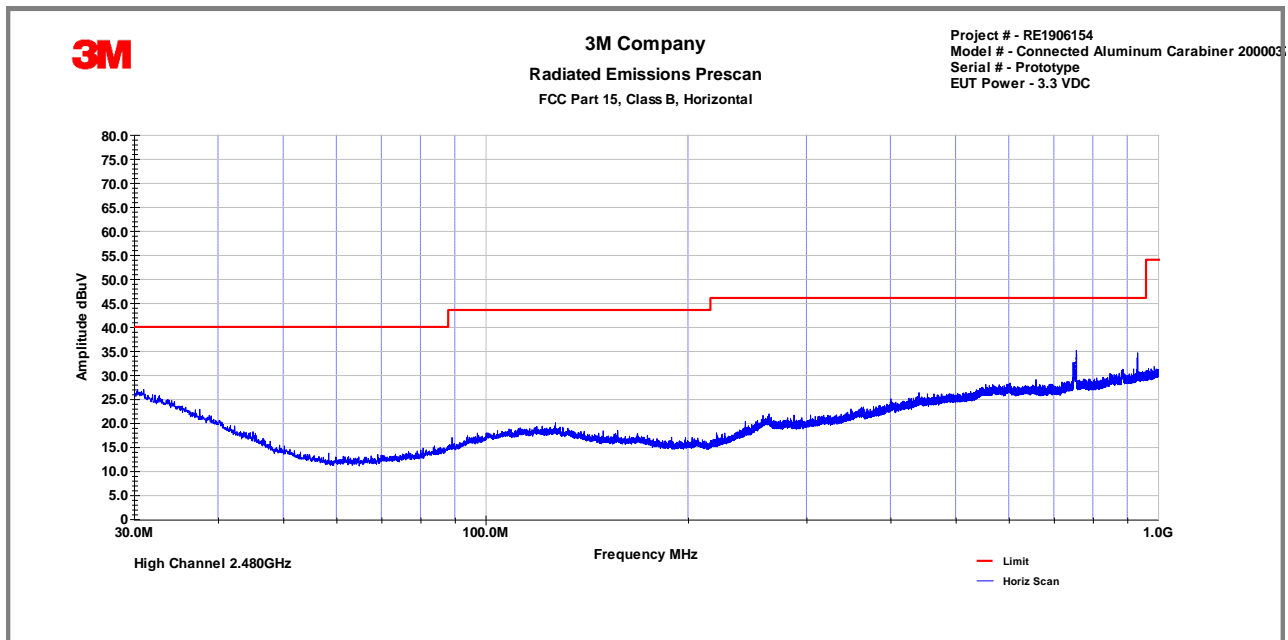
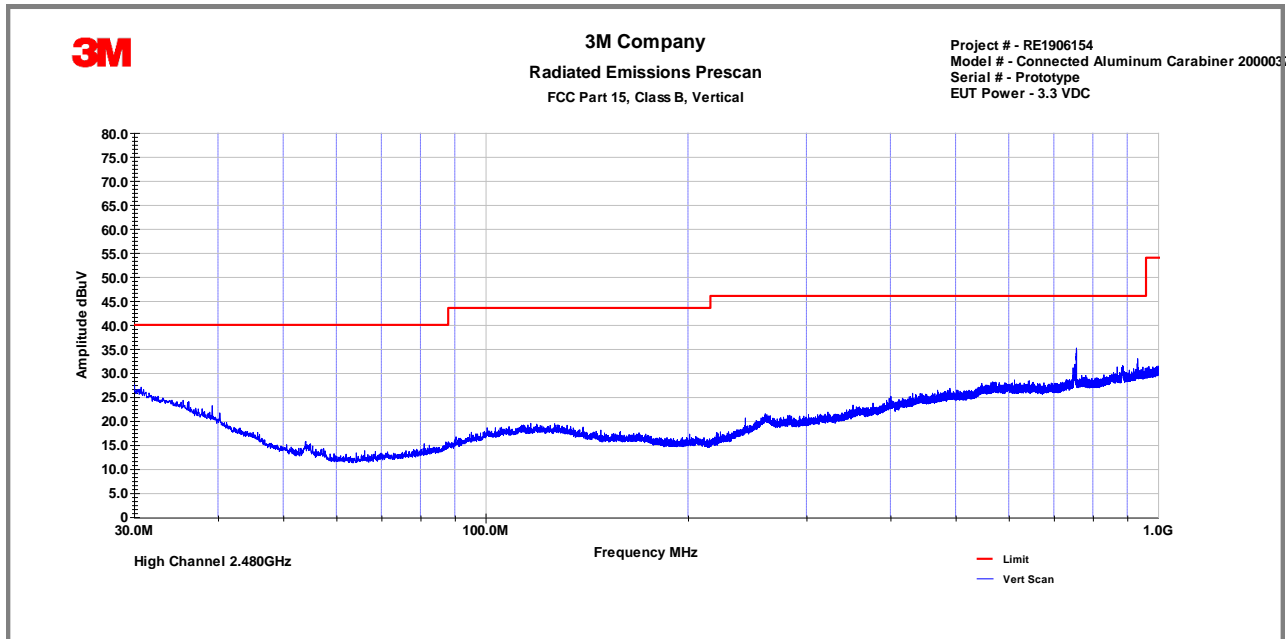
Project # - RE1906154
Model # - Connected Aluminum Carabiner 2000037
Serial # - Prototype
EUT Power - 3.3 VDC Battery



3M Company
Radiated Emissions Prescan
1GHz-18GHz, Horizontal

Project # - RE1906154
Model # - Connected Aluminum Carabiner 2000037
Serial # - Prototype
EUT Power - 3.3 VDC Battery

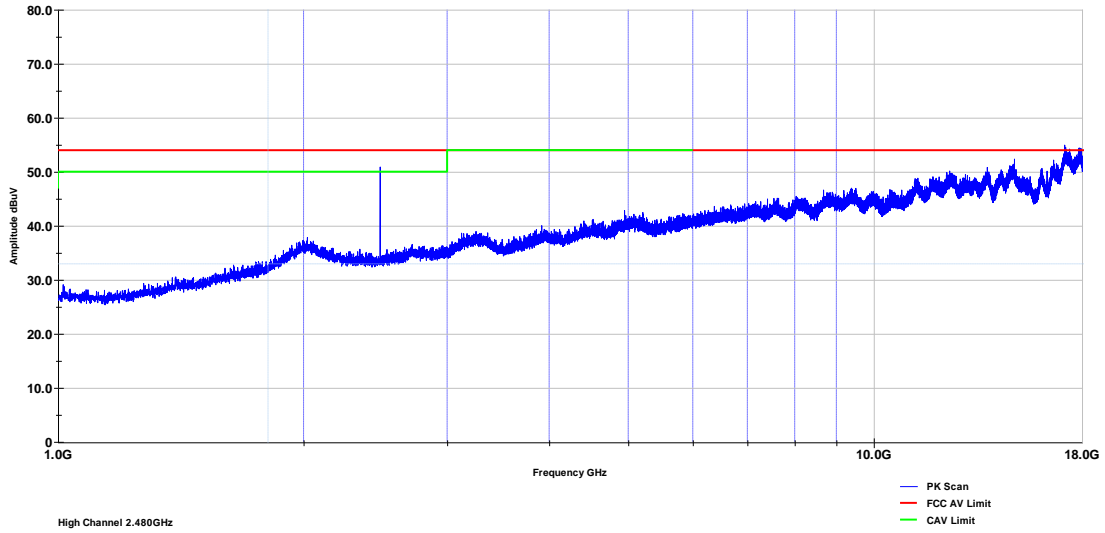






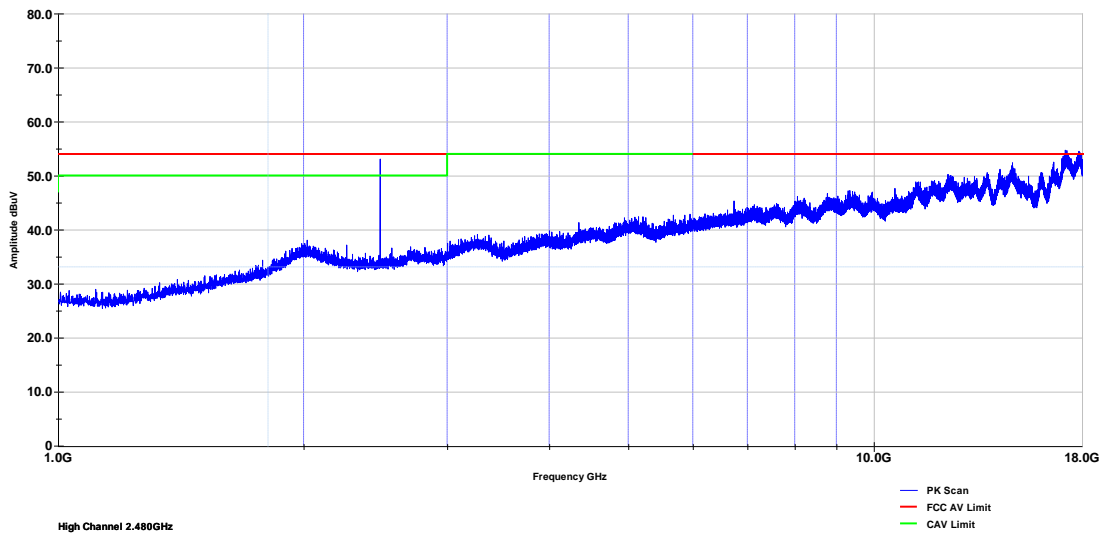
3M Company
Radiated Emissions Prescan
1GHz-18GHz, Vertical

Project # - RE1906154
Model # - Connected Hook - Amazon
Serial # -
EUT Power - 3.3 VDC



3M Company
Radiated Emissions Prescan
1GHz-18GHz, Horizontal

Project # - RE1906154
Model # - Connected Hook - Amazon
Serial # -
EUT Power - 3.3 VDC





Pol	Frequency (MHz)	Peak dB μ V/m	AVG dB μ V/m	Total CF dB	Net Peak dB μ V/m	Net AVE dB μ V/m	PK Limit dB μ V/m	AVE Limit dB μ V/m	PK Margin dB	AVG Margin dB
V	4803.87	51.72	45.1	-6.20	45.52	38.92	74.00	54.00	-28.48	-15.08
H	4803.87	50.78	42.6	-6.20	44.58	36.41	74.00	54.00	-29.42	-17.59
V	7205.80	50.52	42.1	-3.01	47.51	39.08	74.00	54.00	-26.49	-14.92
H	7205.80	49.09	37.9	-3.01	46.08	34.86	74.00	54.00	-27.92	-19.14
V	9607.73	49.01	36.8	-1.07	47.94	35.75	74.00	54.00	-26.06	-18.25
H	9607.73	48.24	36.8	-1.07	47.17	35.75	74.00	54.00	-26.83	-18.25
Notes:	Net Reading (dB μ V) = Reading (dB μ V) + (Antenna with amp CF(dB))+Cable CF(dB))									
	Low Channel									

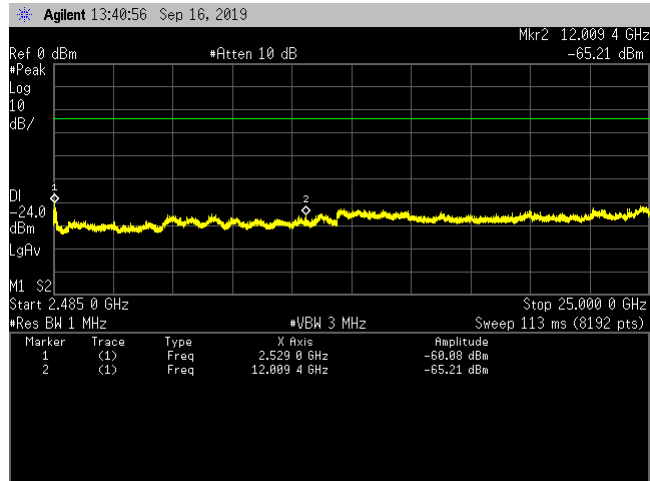
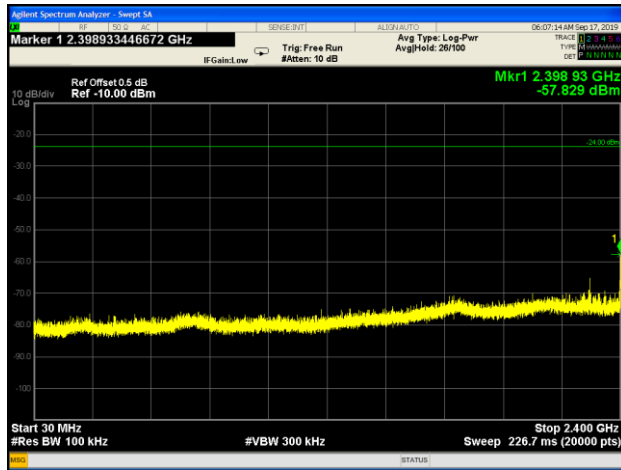
Pol	Frequency (MHz)	Peak dB μ V/m	AVG dB μ V/m	Total CF dB	Net Peak dB μ V/m	Net AVE dB μ V/m	PK Limit dB μ V/m	AVE Limit dB μ V/m	PK Margin dB	AVG Margin dB
V	4879.80	50.24	42.4	-5.39	44.85	37.05	74.00	54.00	-29.15	-16.95
H	4879.80	49.89	41.6	-5.39	44.50	36.17	74.00	54.00	-29.50	-17.83
V	7319.70	50.50	41.1	-3.19	47.31	37.95	74.00	54.00	-26.69	-16.05
H	7319.70	49.75	40.6	-3.19	46.56	37.41	74.00	54.00	-27.44	-16.59
V	9759.60	47.90	37.8	-1.34	46.56	36.41	74.00	54.00	-27.44	-17.59
H	9759.60	48.41	37.6	-1.34	47.07	36.25	74.00	54.00	-26.93	-17.75
Notes:	Net Reading (dB μ V) = Reading (dB μ V) + (Antenna with amp CF(dB))+Cable CF(dB))									
	Mid Channel									

Pol	Frequency (MHz)	Peak dB μ V/m	AVG dB μ V/m	Total CF dB	Net Peak dB μ V/m	Net AVE dB μ V/m	PK Limit dB μ V/m	AVE Limit dB μ V/m	PK Margin dB	AVG Margin dB
V	4959.13	49.83	40.8	-5.15	44.68	35.60	74.00	54.00	-29.32	-18.40
H	4959.13	49.96	41.3	-5.15	44.81	36.12	74.00	54.00	-29.19	-17.88
V	7438.70	49.01	39.1	-2.60	46.41	36.51	74.00	54.00	-27.59	-17.49
H	7438.70	48.65	38.5	-2.60	46.05	35.86	74.00	54.00	-27.95	-18.14
V	9918.27	49.01	39.0	-0.68	48.33	38.33	74.00	54.00	-25.67	-15.67
H	9918.27	49.11	39.5	-0.68	48.43	38.78	74.00	54.00	-25.57	-15.22
Notes:	Net Reading (dB μ V) = Reading (dB μ V) + (Antenna with amp CF(dB))+Cable CF(dB))									
	High Channel									

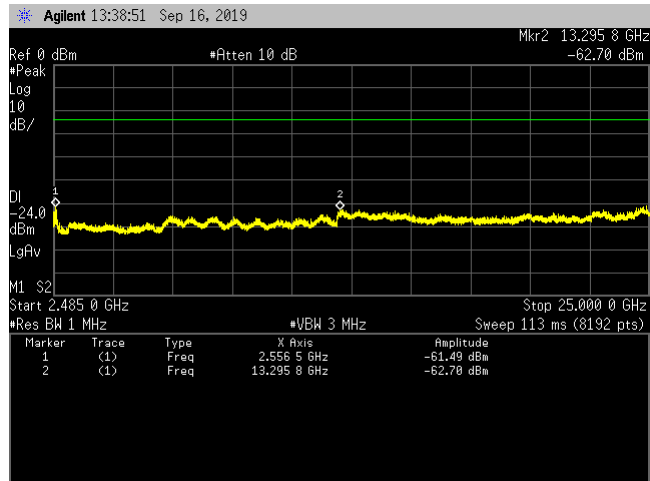
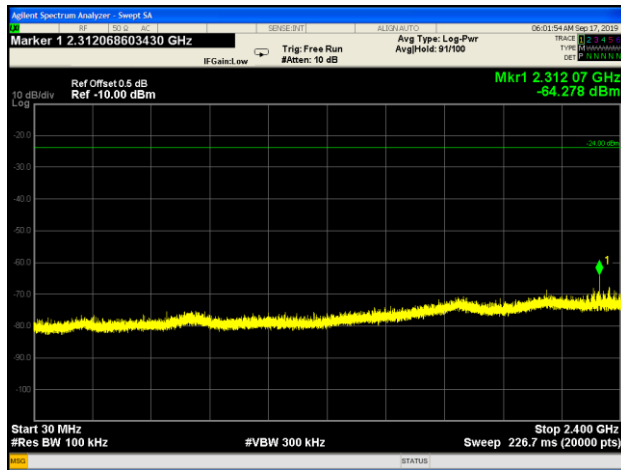


4.2 Radiated Emissions in non-restricted band	
Method:	The measurements were made with transmitter set to transmit continuously low, medium and high channels.
	Laboratory Ambient Temperature: 23°C
	Relative Humidity: 48%
	Atmospheric Pressure: 1011 mbars
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input type="checkbox"/>
Frequency Range:	<input checked="" type="checkbox"/> 2402.0-2480.0 MHz
PSD Level in 100KHz:	<input checked="" type="checkbox"/> -3.8 dBm
Limit:	<input checked="" type="checkbox"/> -23.8dBm (20dBc below Peak PSD level)
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 3VDC
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>
	Measurement Point <input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated
	Results: >38dBc
Date:	06/19/2019

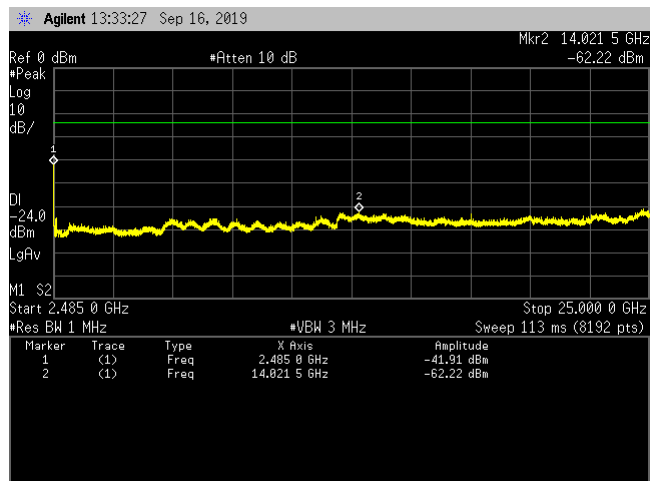
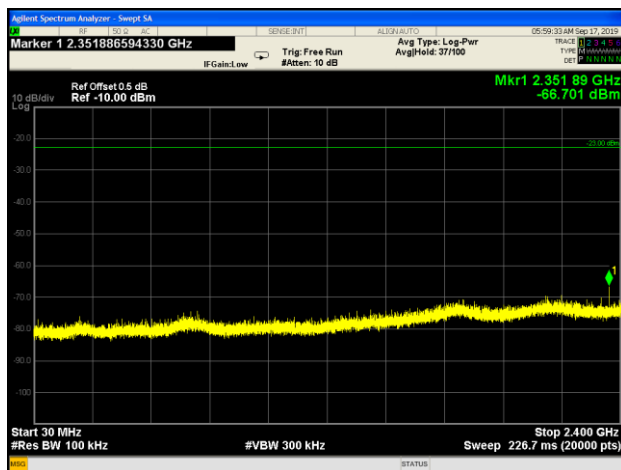
Note:



Conducted Spurious - Low Channel



Conducted Spurious - Mid Channel



Conducted Spurious - High Channel



5.0	Test Equipment				
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Last Cal. Date	Check
Biconilog Antenna	Schaffner	CBL6112B	27491	10/20/2018	<input checked="" type="checkbox"/>
Horn Antenna	A.H. Systems	SAS 571	1010	10/20/2018	<input checked="" type="checkbox"/>
Loop Antenna	A.H. Systems	EHA-51B	1213E	10/20/2018	<input type="checkbox"/>
EMI Receiver	Rohde & Schwarz	ESW26	101412	03/11/2019	<input checked="" type="checkbox"/>
Signal Analyzer	Agilent	N9000A	MY53031040	10/20/2018	<input checked="" type="checkbox"/>
EMI Receiver	Agilent	E4448A	1530975	10/20/2018	<input checked="" type="checkbox"/>
LISN	TESEQ	NNB51	1130	10/20/2018	<input type="checkbox"/>
EMF Meter	NARDA	ELT400	1139	10/20/2018	<input type="checkbox"/>
EMF E-field Probe	NARDA	Type 8.3 100KHz-3GHz	K-0014	10/20/2018	<input type="checkbox"/>
EMF H-field Probe	NARDA	Type 12.1 300KHz-30MHz	AP-0004	10/20/2018	<input type="checkbox"/>
Coaxial Cable	Insulated Wire	2803	CBL2039	10/21/2018	<input checked="" type="checkbox"/>
EMC Software	ETS-Lindgren	TILE 7		10/20/2018	<input checked="" type="checkbox"/>
Equipment Calibration Interval:		<input checked="" type="checkbox"/> 12 months <input type="checkbox"/> 24 months			

6.0	Report revision history		
Revision Level	Date	Report Number	Notes
0	09/23/2019	RE1906154-3	Original Issue