EMC TEST REPORT

NVLAP Lab Code 200033-0

Standard(s):

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

FCC ID: DGFPSD2000217
IC:458A-PSD2000217

Product: 3M™ Comfort Grip Connected Hook
Model(s): 2000217

Company Name:
3M Company

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

Report Number: RE1701014-1
Report Issue Date: February 22, 2019

Report Prepared by:

Signature:
Yuriy Litvinov
Lead EMC Engineer

Tested by:
3M EMC Laboratory
410 E. Fillmore Avenue, Building 76-01-1
St. Paul, Minnesota 55107-1000, USA

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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	15.247(a)(2)/ RSS247,5.2/RSS Gen, 6.6	DTS Bandwidth	**pass**	
4.2	15.247(b)(3)/ RSS 247, 5.4(d)	Maximum Peak Conducted Output Power	**pass**	
4.3	Part 15.247(e)/ RSS 247, 5.2(b)	Maximum Power Spectral Density level	**pass**	
4.4	15.209/RSS Gen, 8.9	Radiated Emissions in restricted band	**pass**	
4.5	15.247(d)/RSS 247,5.5	Radiated Emissions in non-restricted band	**pass**	
4.6	15.247(d)(1)/ RSS 247, 5.5	DTS Band-edge Emissions Measurements	**pass**	
4.7	Part 15.207/RSS-Gen, 8.8	Conducted Emissions	**N/A**	See note
4.8	Part 15.247(i)/ RSS 102	RF Exposure Compliance	**pass**	

Note:	Device is Battery operated

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 snap hook			
Model(s):	2000217			
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:	5.7dBm(3.7mW)			
Antenna Type:	Internal Chip Antenna			
Antenna Gain:	1.1dBi			
Test Deviations or Exclusions	☐ Yes	☒ No		
Rated Power:	**Voltage:**	☐ 120VAC	☐ 230VAC	☒ 9.0VDC
	Phase:	☐ 1ph	☐ 3ph	☒ Battery
	Frequency:	☐ 50Hz	☐ 60Hz	
	Current:			
Test Dates:	01/29-02/13/2019			
Received Date:	01/29/2019			
Received Conditions:	☐ Poor	☒ Good		
	☒ Prototype	☐ Production		

3.0 EUT Configuration

3.1 System Configuration

No.	Product Type	Manufacturer	Model	Comments
1	Connected Hook	3M	2000217	

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
☒	Table-top only	
☐	Floor-standing only	
☐	Floor-standing or table-top	
☒	Other	Body worn

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	

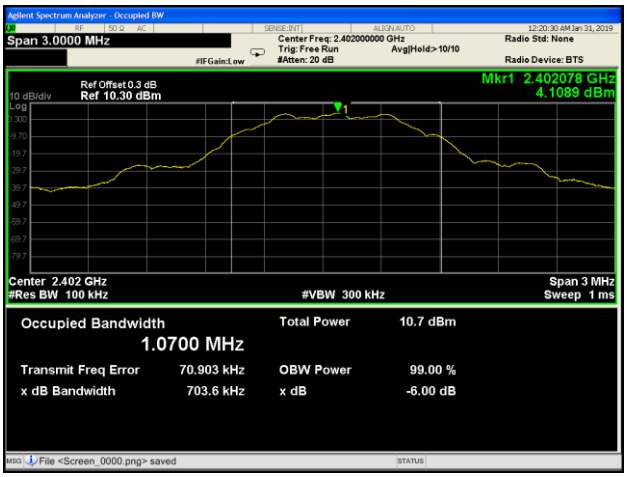
3.6 Exercising of EUT and Interfaces

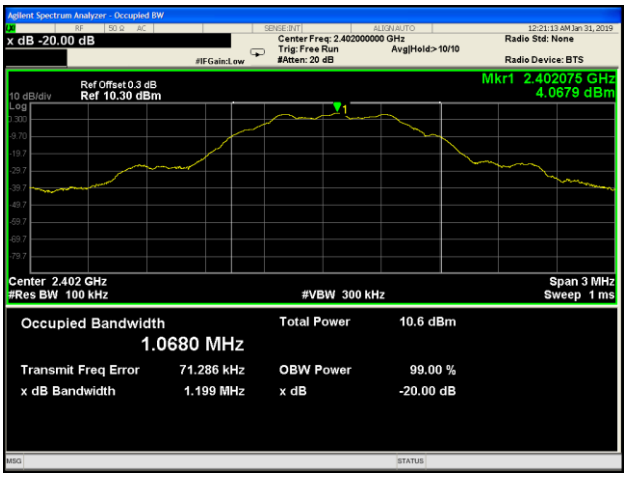
No.	Mode of Operation
1	Transmitting at lowest, middle and highest channels of operation with unmodulated CW carrier
2	Device programming using Nordic Studio BT software for continues transmission of modulated carrier at maximum rated RF output power and Duty Cycle.

4.0 Test Conditions and Results

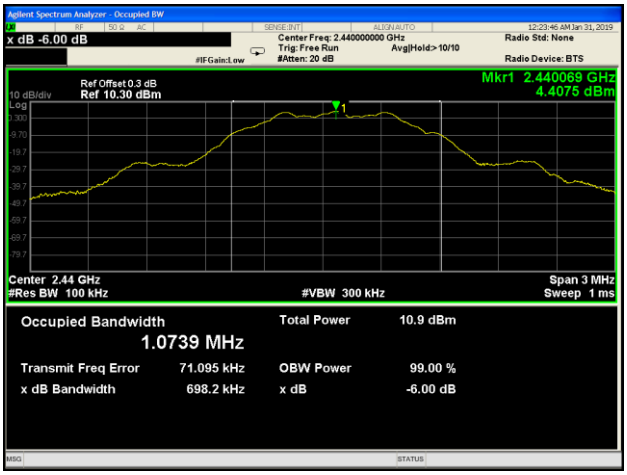
4.1	DTS Bandwidth	
	Laboratory Ambient Temperature:	23°C
	Relative Humidity:	18%
	Atmospheric Pressure:	836.8 mbars
Reference Standard(s):	☒ ANSI C63.10:2013 ☒ FCC Part 15.247/RSS 247	**Measurement Point** ☒ Conducted ☐ Radiated
Frequency Range:	☒ 2402.0-2480.0 MHz	RBW = 100KHz VBW ≥ 3 x RBW
Nominal Voltage:	☐ 120VAC ☒ 9.0 VDC	
Test Personnel:	Yuriy Litvinov	**Date: 01/31/2019**

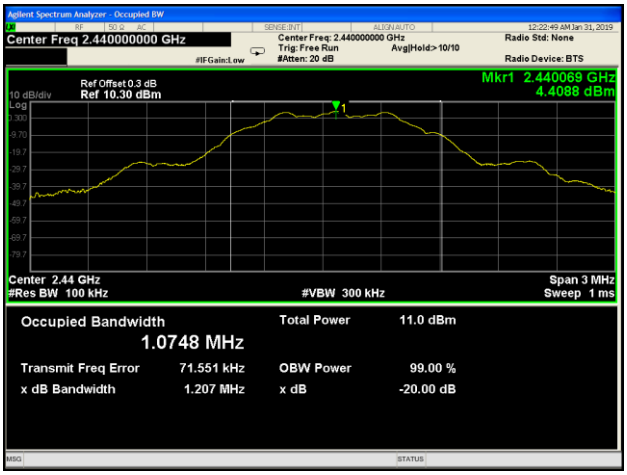
Frequency (MHz)	99% dB Bandwidth (KHz)	20 dB Bandwidth (KHz)	6 dB Bandwidth (KHz)	6dB OBW Limit (KHz)	Results
2402	1070.0	1199.0	703.6	**> 500**	**pass**
2440	1074.0	1207.0	698.2	**> 500**	**pass**
2480	1073.0	1202.0	708.2	**> 500**	**pass**



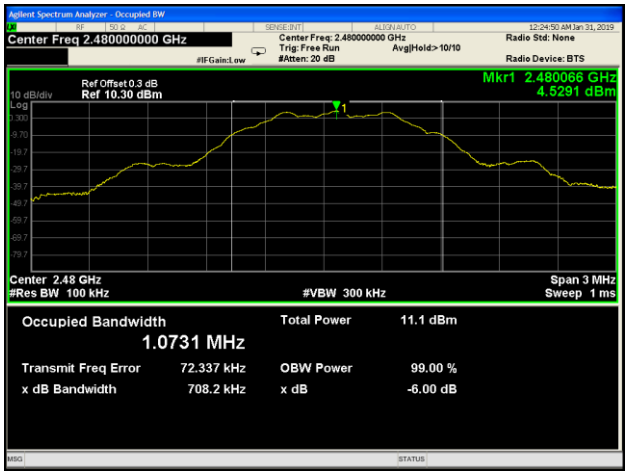


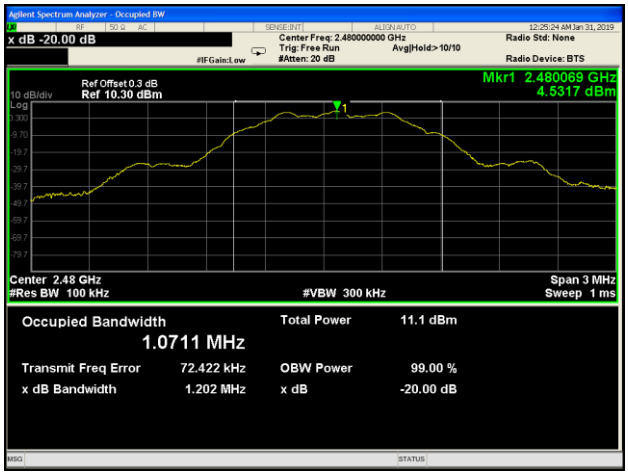
OBW – Low Channel





OBW – Mid Channel

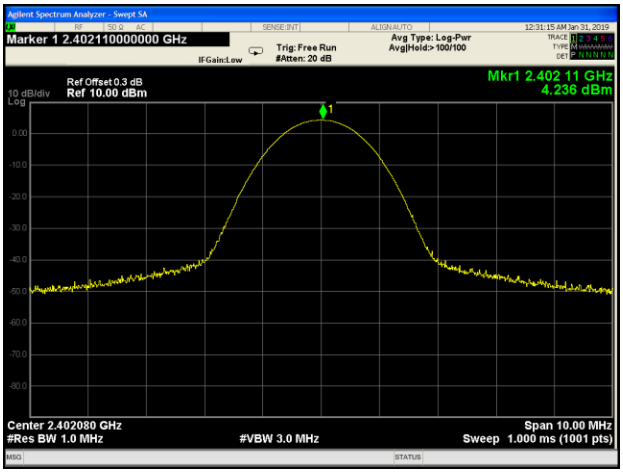




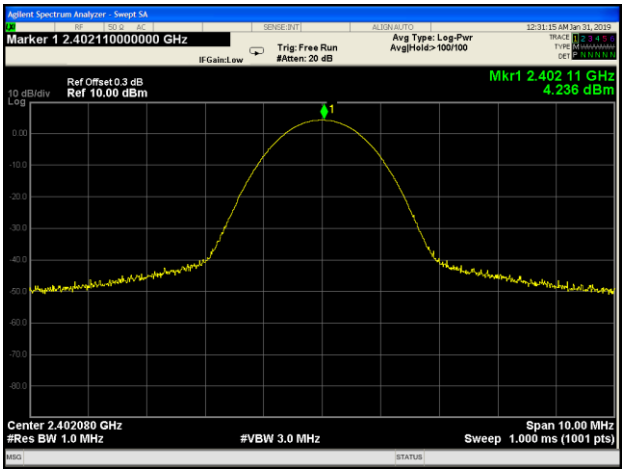
OBW – High Channel

4.2	**Maximum Output Power**	
Method:	Measurements was performed with CW carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.	
	Laboratory Ambient Temperature:	23°C
	Relative Humidity:	18%
	Atmospheric Pressure:	836.8 mbars
Reference Standard(s):	☒ ANSI C63.10:2013 ☒ FCC Part 15.247/RSS 247 ☒ KDB 558074	**Measurement Point** ☒ Conducted ☐ Radiated at 3 meters
Frequency Range:	☒ 2402.0 – 2480.0 MHz	
Antenna Gain:	1.1 dBi	**Maximum Conducted Power (EIRP):**
Limit:	30 dBm	5.7 dBm
Nominal Voltage:	☐ 120VAC ☒ 9VDC	
Test Personnel:	Yuriy Litvinov	**Date: 01/31/2019**

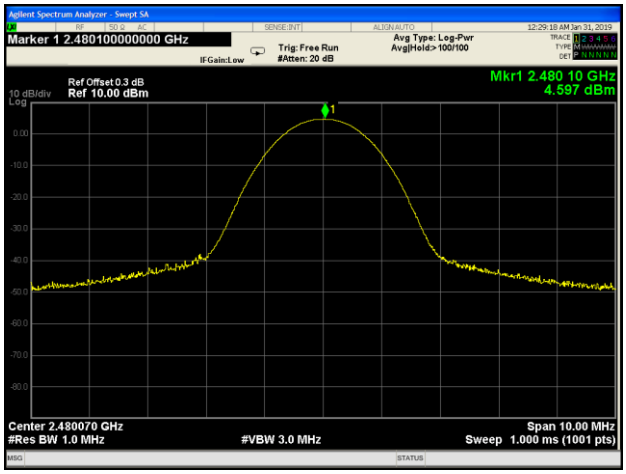
Note:	EIRP (dBm) = Conducted Power (dBm) +Antenna Gain (dBi)=4.6+1.1=5.6dBm



Low Channel

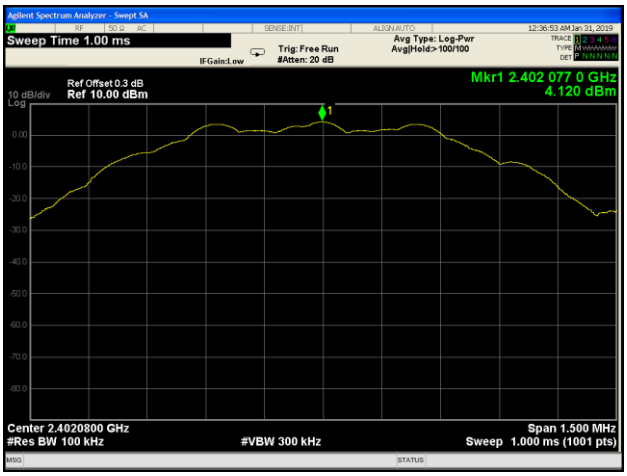


Mid Channel



High Channel

4.3	**Maximum Power Spectral Density level**	
Method:	Measurements was performed with modulated carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.	
	Laboratory Ambient Temperature:	23°C
	Relative Humidity:	18%
	Atmospheric Pressure:	836.8 mbars
Reference Standard(s):	☒ ANSI C63.10:2013 ☒ FCC Part 15.247/RSS 247 ☒ KDB 558074 D01	**Measurement Point** ☒ Conducted ☐ Radiated at 3 meters
Frequency Range:	☒ 2402.0 – 2480.0 MHz	**PSD Results**
PSD Limit:	8 dBm	4.5 dBm
Nominal Voltage:	☐ 120VAC ☒ 9VDC	
Test Personnel:	Yuriy Litvinov	**Date: 01/31/2019**



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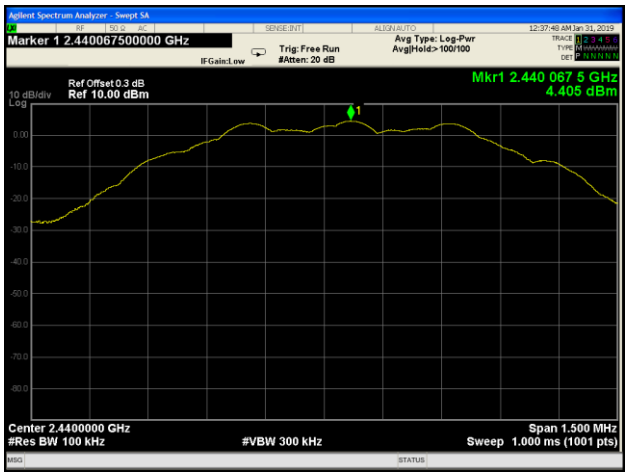

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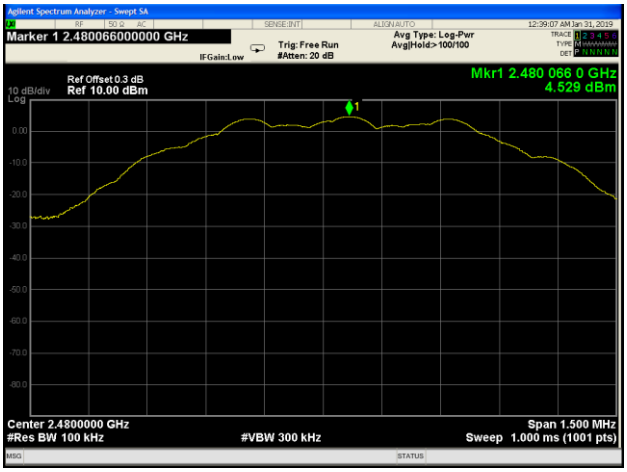


PSD High Channel

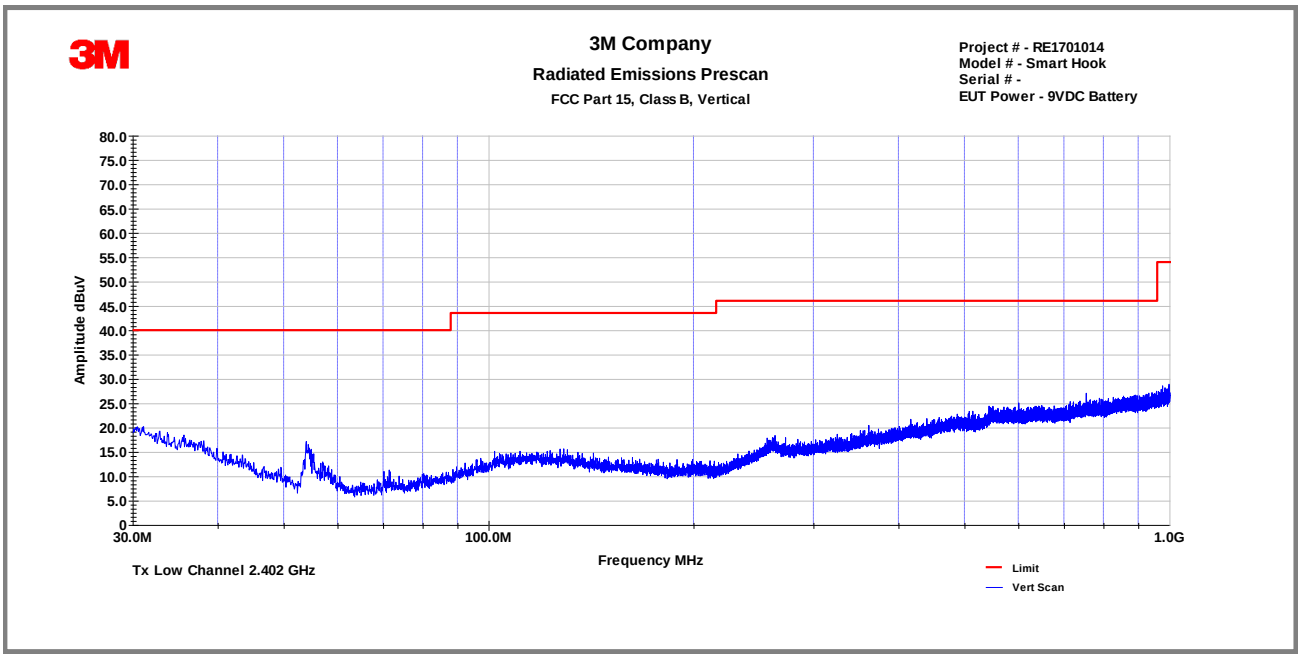
4.4	**Radiated Emissions in restricted band**
Method:	Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4. EUT was rotated through three orthogonal axes to determine which attitude (orientation) and arrangement produces the highest emission relative to the limit; 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 ware 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: ☒	Laboratory Ambient Temperature:	23°C
	Relative Humidity:	18%
	Atmospheric Pressure:	836.8 mbars
Reference Standard(s):	☐ ANSI C63.4:2014:2014 ☒ ANSI C63.10:2013:2013 ☒ FCC Part 15.247 ☐	**Measurement Distance** ☒ 3 Meters ☐
Frequency Range:	☒ 30 MHz to 1 GHz ☒ 1 GHz to 26 GHz	
Nominal Voltage:	☐ 120VAC ☒ 9VDC	
Test Personnel:	Keith Schwartz KS	**Date: 01/30/2019**

Limits – 15.109, Class A

Frequency (MHz)	Limit dB (µV/m)				
	Quasi-Peak	Average	Peak	Distance	Results
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:	For emission in the restricted bands, the limit of 15.209 was used. 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. No radiated spurious emissions were detected below 1GHz and above 18GHz.


3M Company
Radiated Emissions Prescan
FCC Part 15, Class B, Vertical
Project # - RE1701014
Model # - Smart Hook
Serial # -
EUT Power - 9VDC Battery
Amplitude dBuV
80.0
75.0
70.0
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30.0
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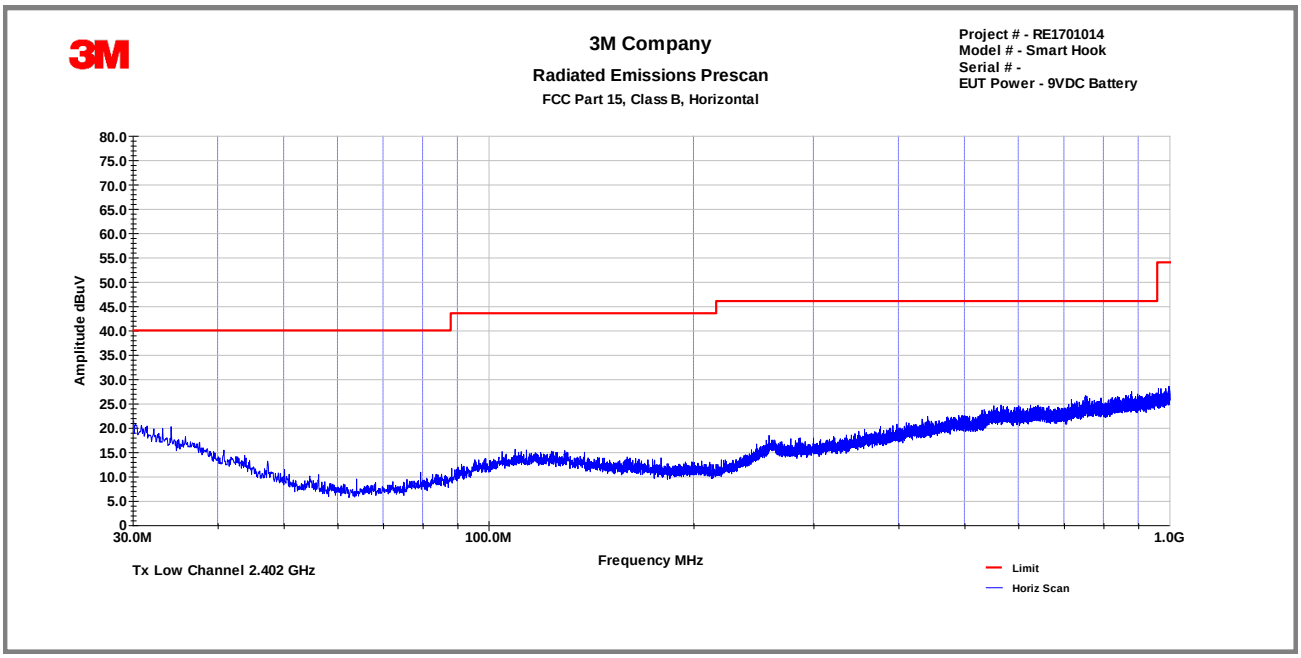
Frequency MHz
Tx Low Channel 2.402 GHz
Limit
Vert Scan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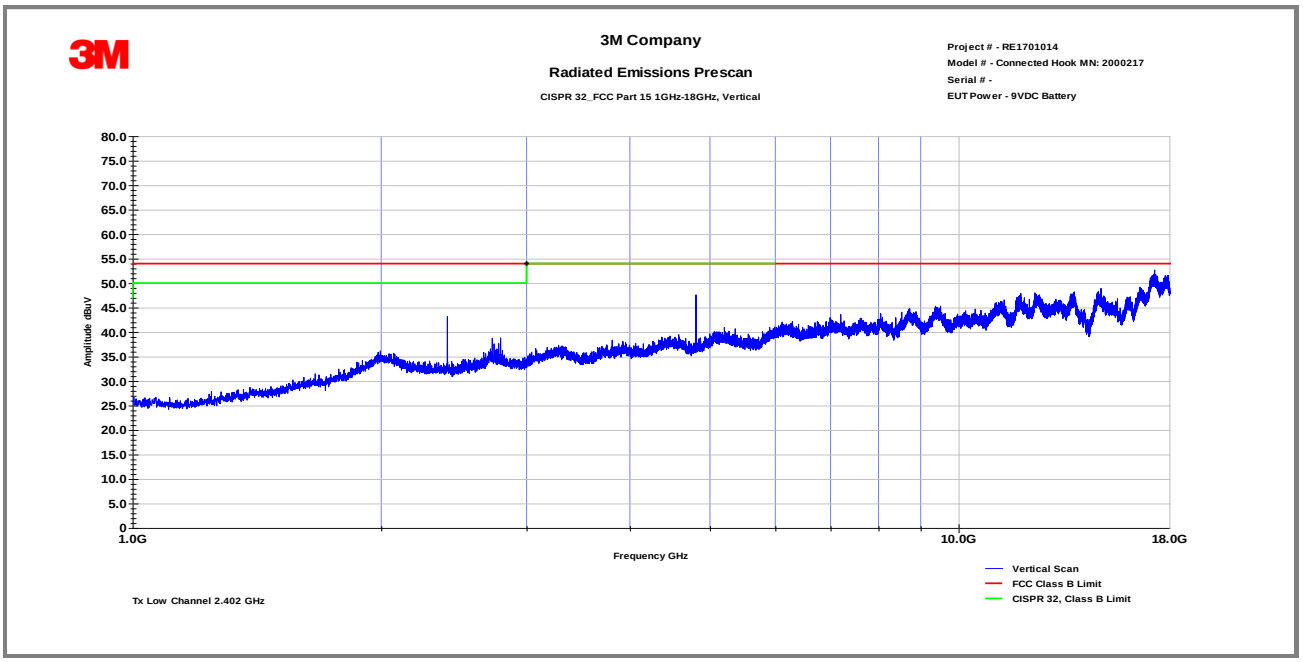
100.0M
1.0G
Frequency MHz
Tx Low Channel 2.402 GHz
Limit
Horiz Scan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80.0
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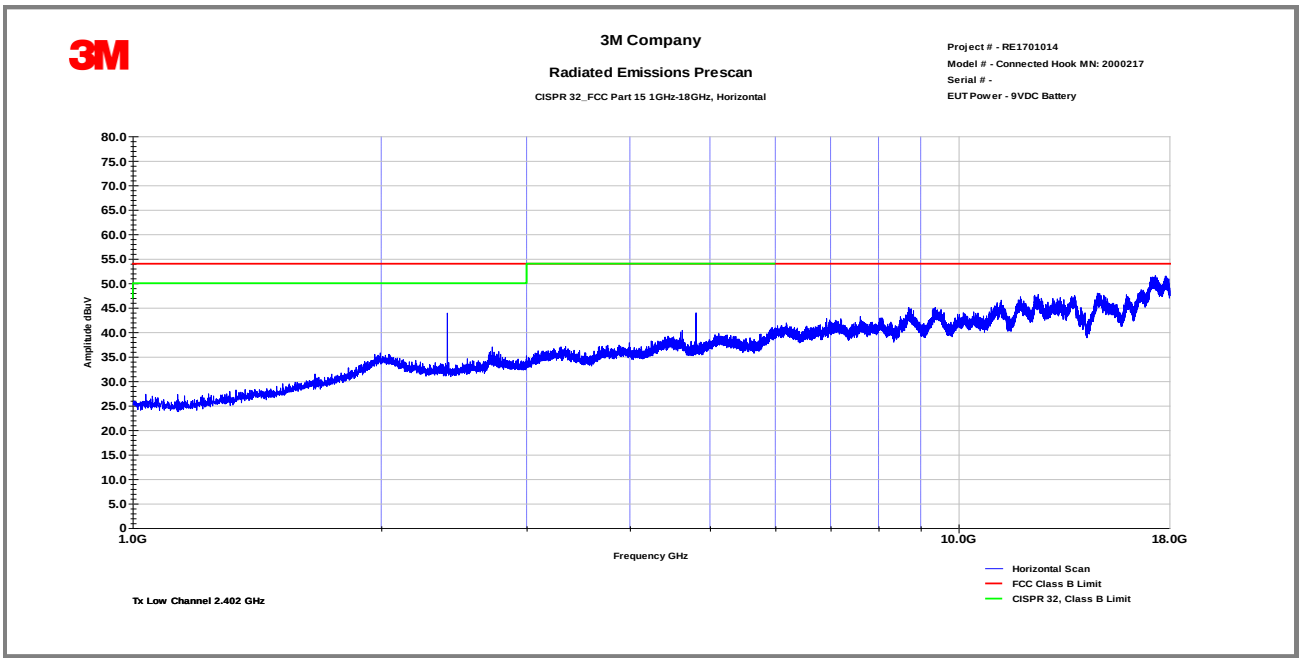
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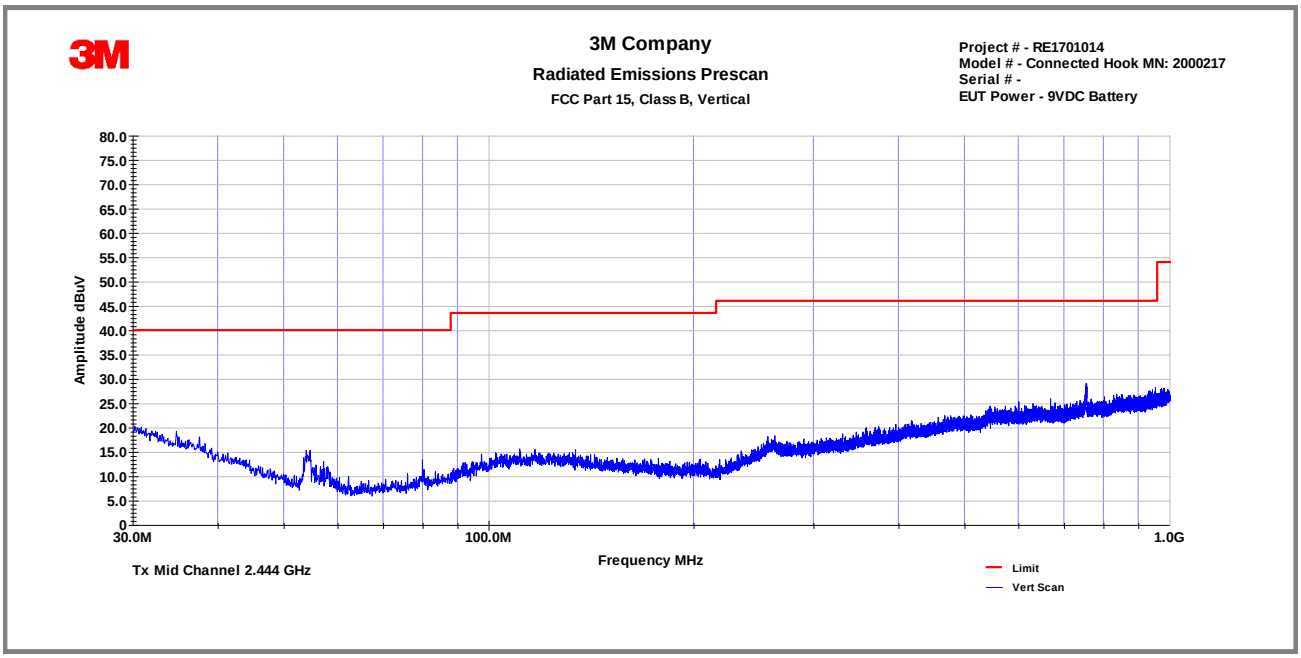
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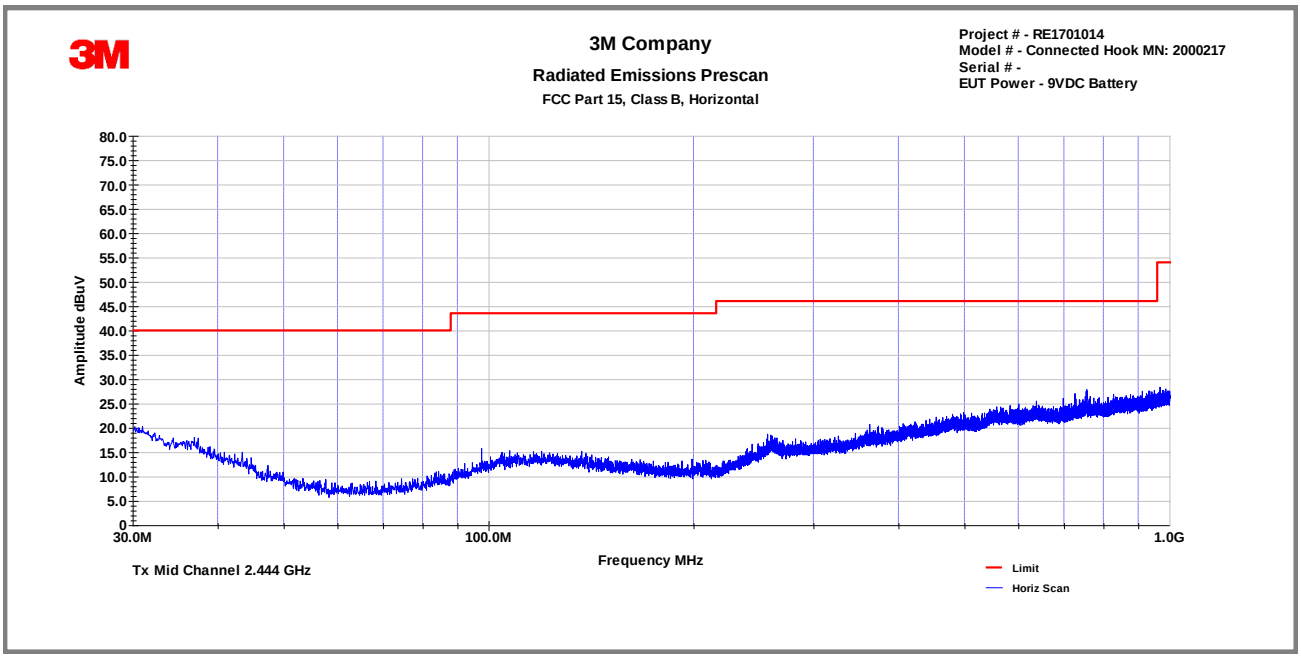
Tx Mid Channel 2.444 GHz
Limit
Vert Scan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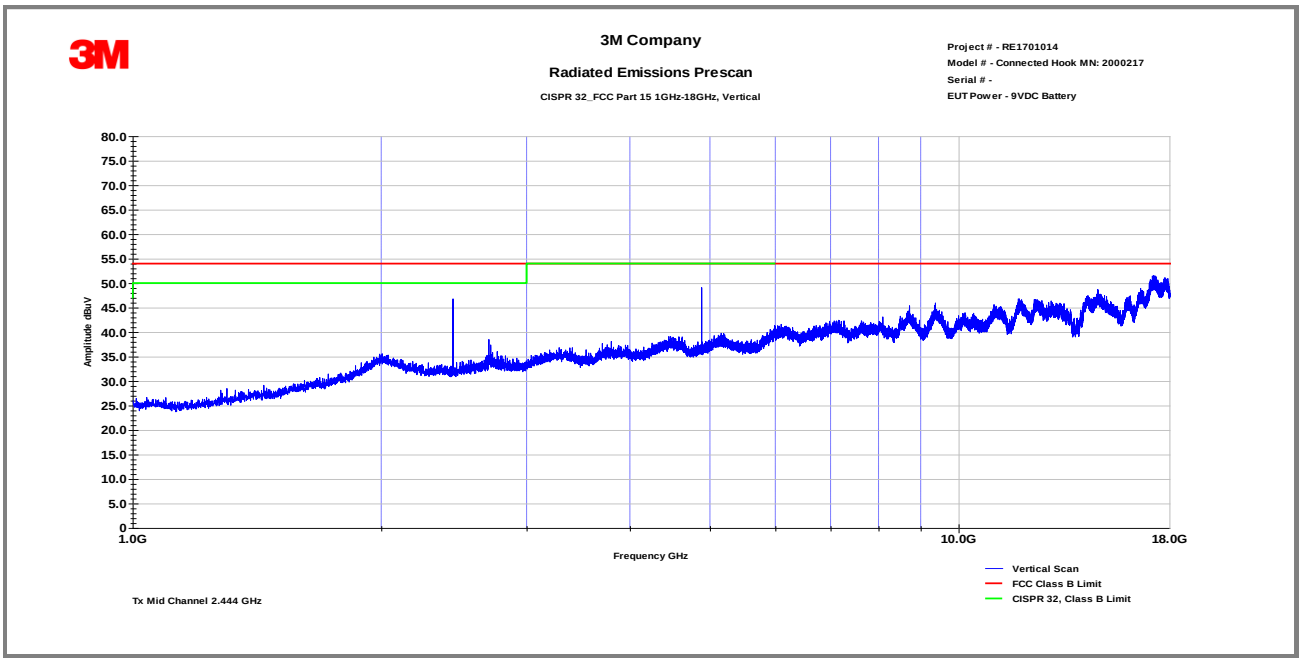
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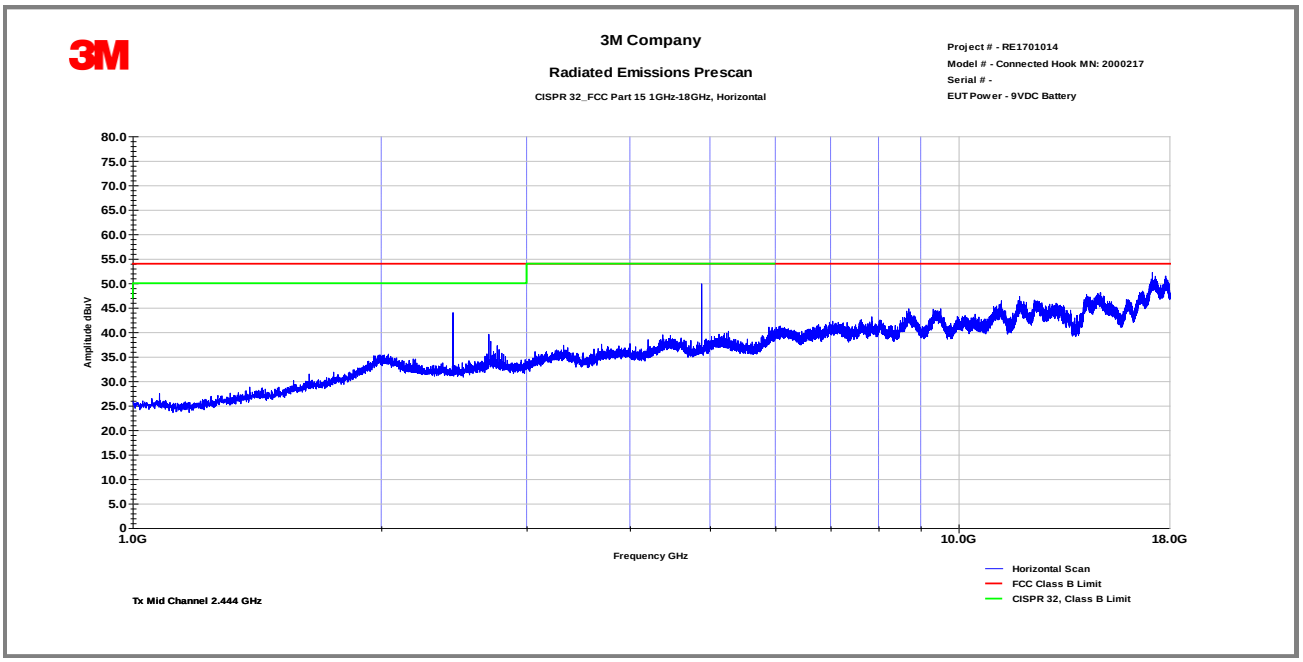
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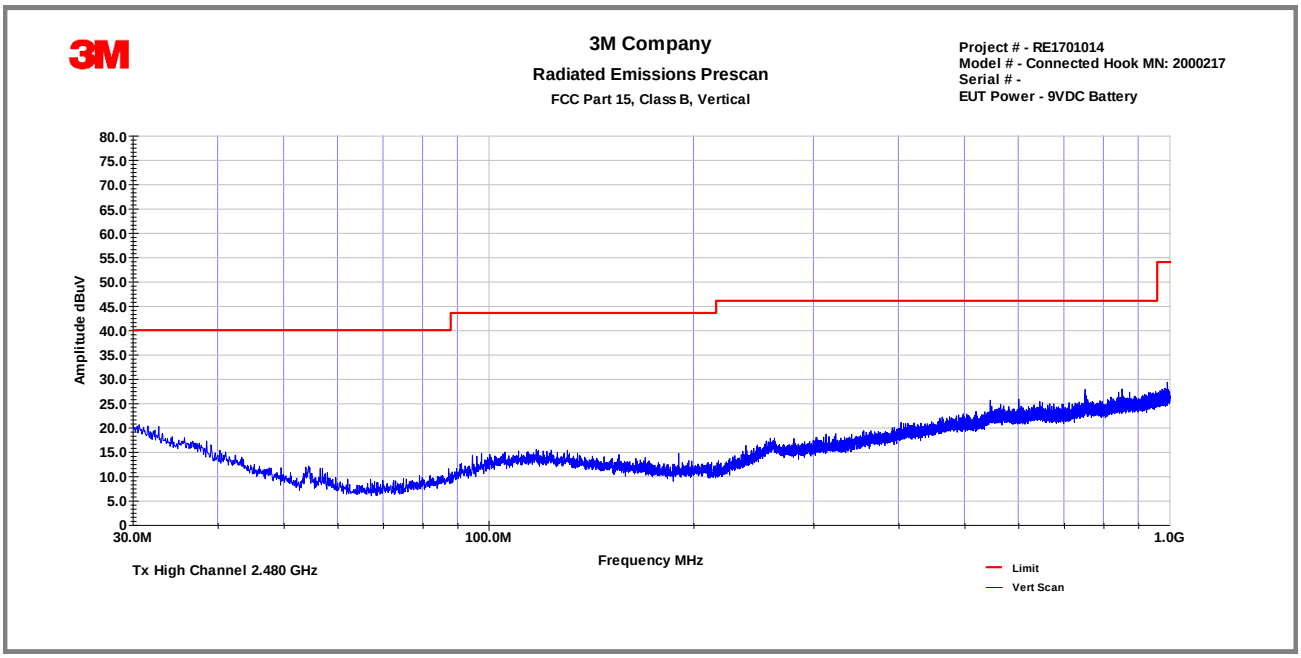
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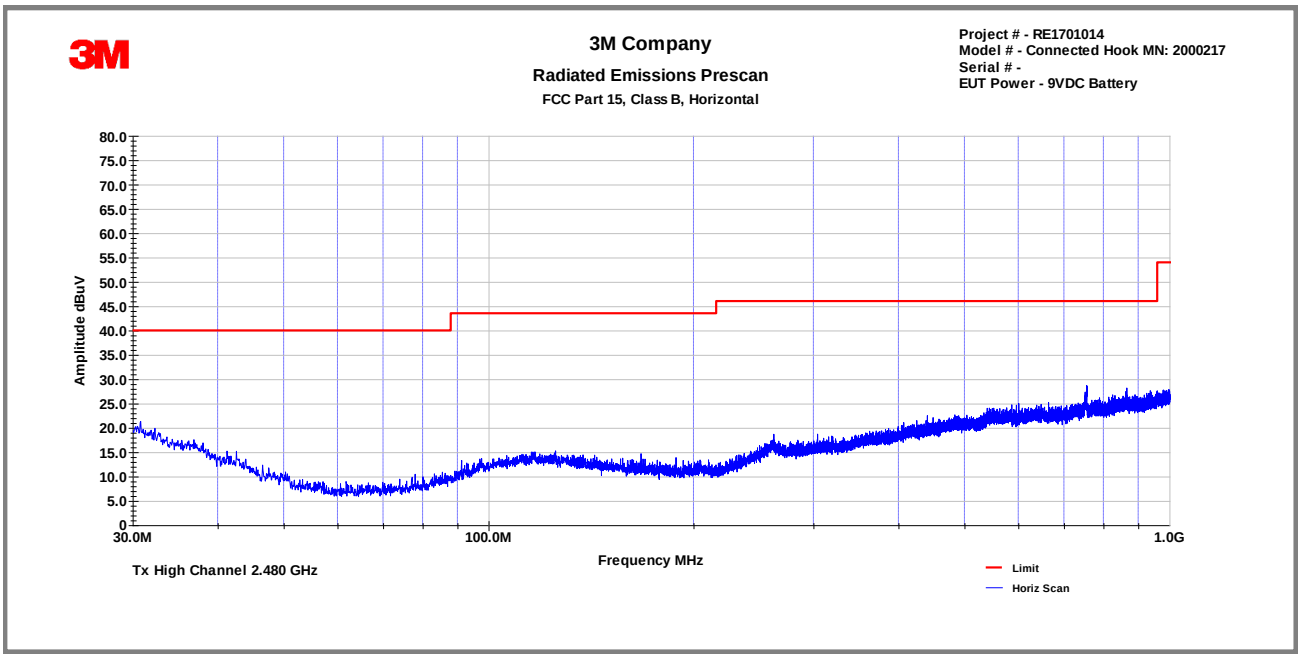
Limit
Vert Scan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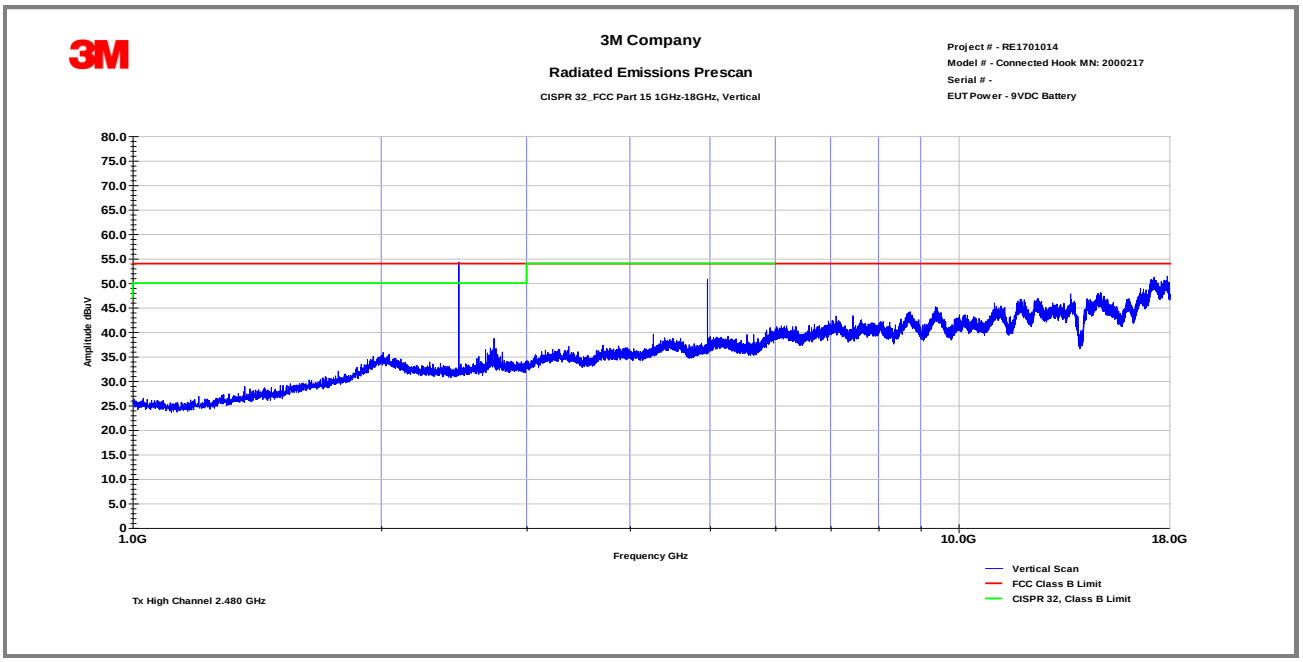
1.0G
Frequency MHz
Tx High Channel 2.480 GHz
Limit
Horiz Scan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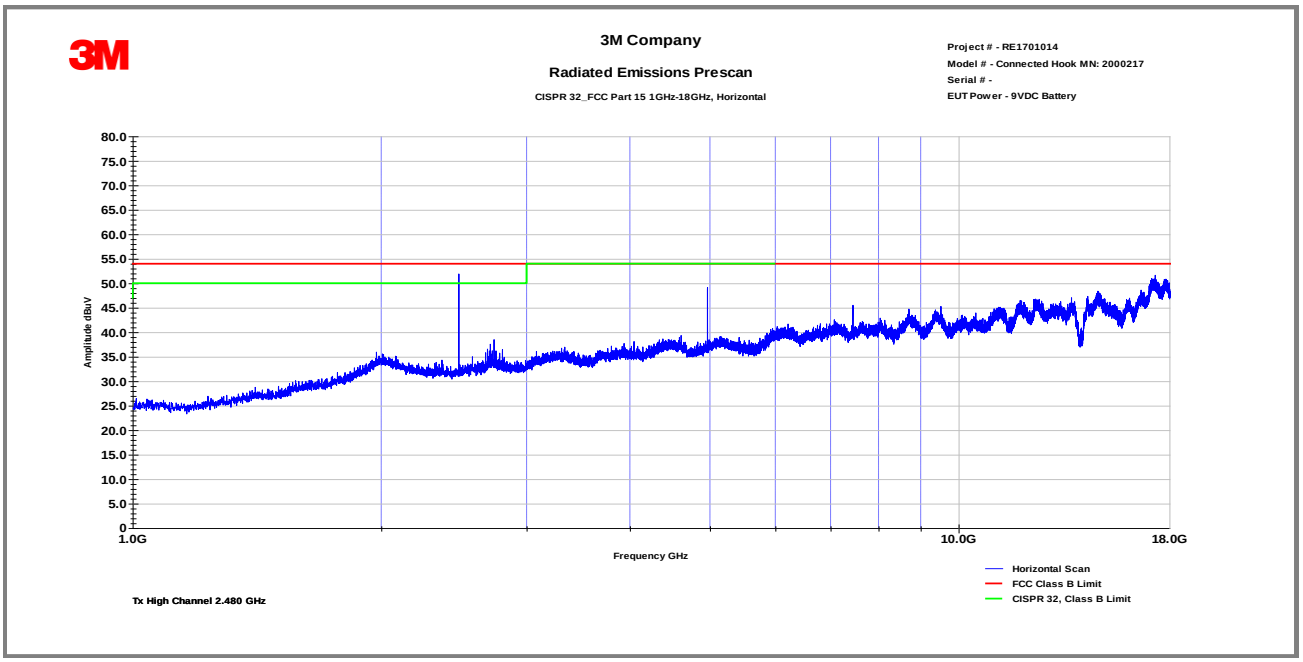
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CISPR 32_FCC Part 15 1GHz-18GHz, Horizontal
Project # - RE1701014
Model # - Connected Hook MN: 2000217
Serial # -
EUT Power - 9VDC Battery
Amplitude dBuV
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
1.0G
10.0G
18.0G
Frequency GHz
Horizontal Scan
FCC Class B Limit
CISPR 32, Class B Limit
Tx High Channel 2.480 GHz

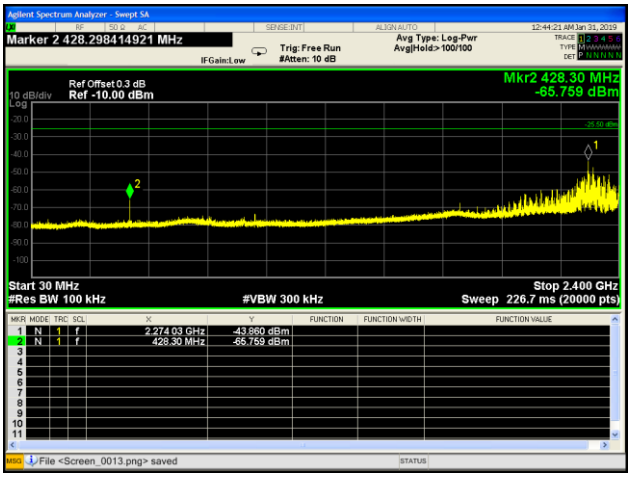
Pol	Frequency (GHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit dBµV/m.	AVE Limit dBµV/m	PK Margin dBµV/m	AVG Margin dB
V	4.804	51.6	50.6	-6.3	45.3	44.3	74	54	-28.7	-9.7
V	7.206	45.4	38.0	-3.0	42.4	35.0	74	54	-31.6	-19.0
V	9.391	42.3	34.1	0.0	42.3	34.1	74	54	-31.7	-19.9
H	4.804	49.4	47.5	-6.3	43.1	41.2	74	54	-30.9	-12.8
H	7.206	45.2	38.2	-3.0	42.2	35.2	74	54	-31.8	-18.8
H	9.391	42.3	34.5	0.0	42.3	34.5	74	54	-31.7	-19.5
Notes:		Net Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB))								
		Low Channel								

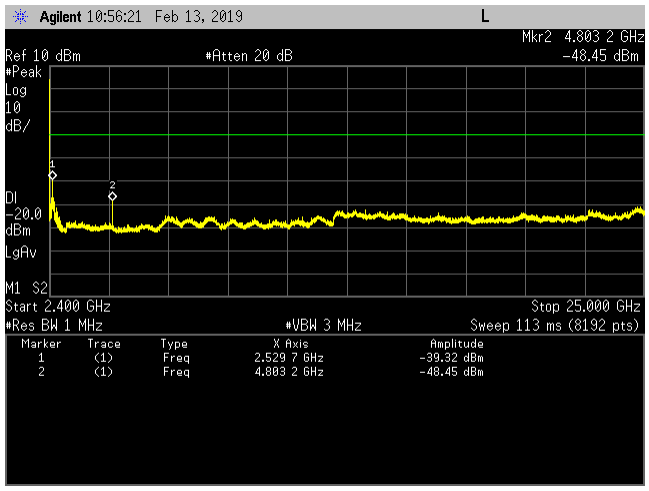
Pol	Frequency (GHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit dBµV/m.	AVE Limit dBµV/m	PK Margin dBµV/m	AVG Margin dB
V	4.888	54.2	53.0	-5.8	48.4	47.2	74	54	-25.6	-6.8
V	7.320	45.3	35.5	-3.2	42.1	32.3	74	54	-31.9	-21.7
V	9.770	41.9	33.2	-1.3	40.6	31.9	74	54	-33.4	-22.1
H	4.888	58.0	54.8	-5.8	52.2	49.0	74	54	-21.8	-5.0
H	7.330	46.5	37.8	-3.2	43.3	34.6	74	54	-30.7	-19.4
H	9.770	41.2	33.5	-1.3	39.9	32.2	74	54	-34.1	-21.8
Notes:		Net Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB))								
		Mid Channel								

Pol	Frequency (GHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit dBµV/m.	AVE Limit dBµV/m	PK Margin dBµV/m	AVG Margin dB
V	4.960	54.7	53.6	-5.2	49.5	48.4	74	54	-24.5	-5.6
V	7.440	41.0	37.5	-2.4	38.6	35.1	74	54	-35.4	-18.9
V	9.920	30.7	25.7	-0.7	30.0	25.0	74	54	-44.0	-29.0
H	4.960	54.7	53.5	-5.2	49.5	48.3	74	54	-24.5	-5.7
H	7.440	44.3	43.3	-2.4	41.9	40.9	74	54	-32.1	-13.1
H	9.920	31.6	26.3	-0.7	30.9	25.6	74	54	-43.1	-28.4
Notes:		Net Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB))								
		High Channel								

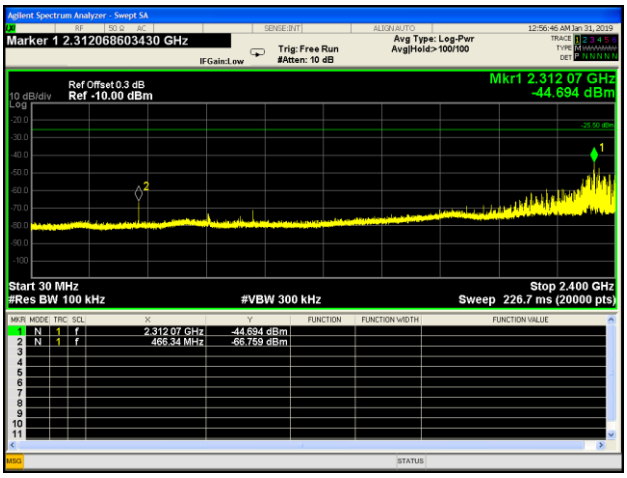
4.5	**Radiated Emissions in non-restricted band**	
Method:	The measurements were made with transmitter set to transmit continuously low, medium and high channels.	
	Laboratory Ambient Temperature:	23°C
	Relative Humidity:	18%
	Atmospheric Pressure:	836.8 mbars
Reference Standard(s):	☒ ANSI C63.10:2013 ☒ FCC Part 15.247/RSS 247 ☐	**Measurement Point** ☒ Conducted ☐ Radiated
Frequency Range:	☒ 2402.0-2480.0 MHz	
PSD Level in 100KHz:	☒ 4.5 dBm	**Results:**
Limit:	☒ -25.5dBm (30dBc below PSD)	>46.5dBc
Nominal Voltage:	☐ 120VAC ☒ 9VDC	
Test Personnel:	Yuriy Litvinov	**Date: 02/13/2019**

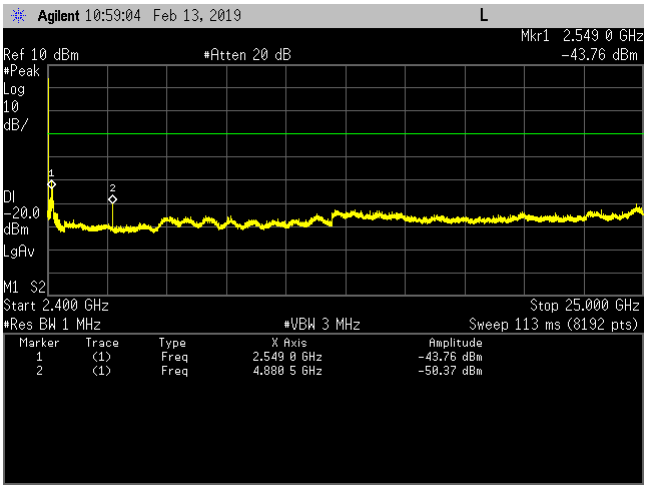
Note:	



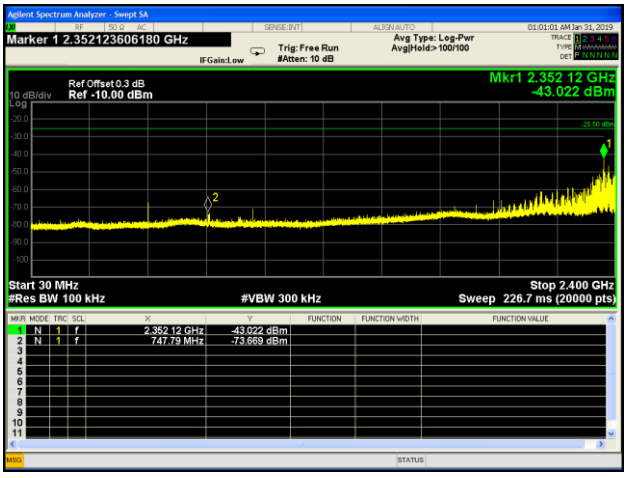


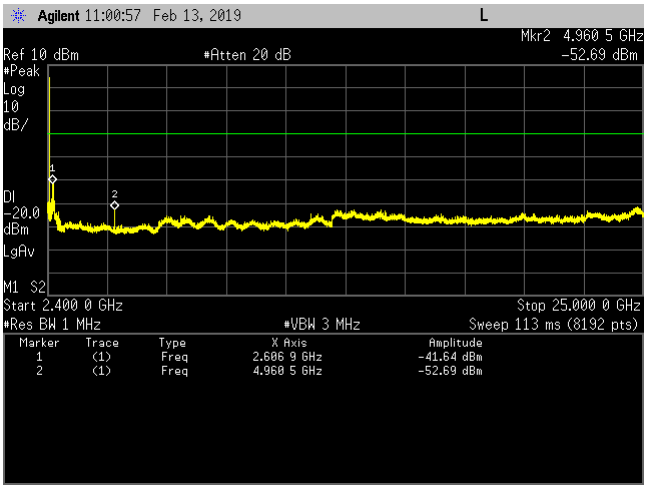
Conducted Spurious - Low Channel





Conducted Spurious – Mid Channel

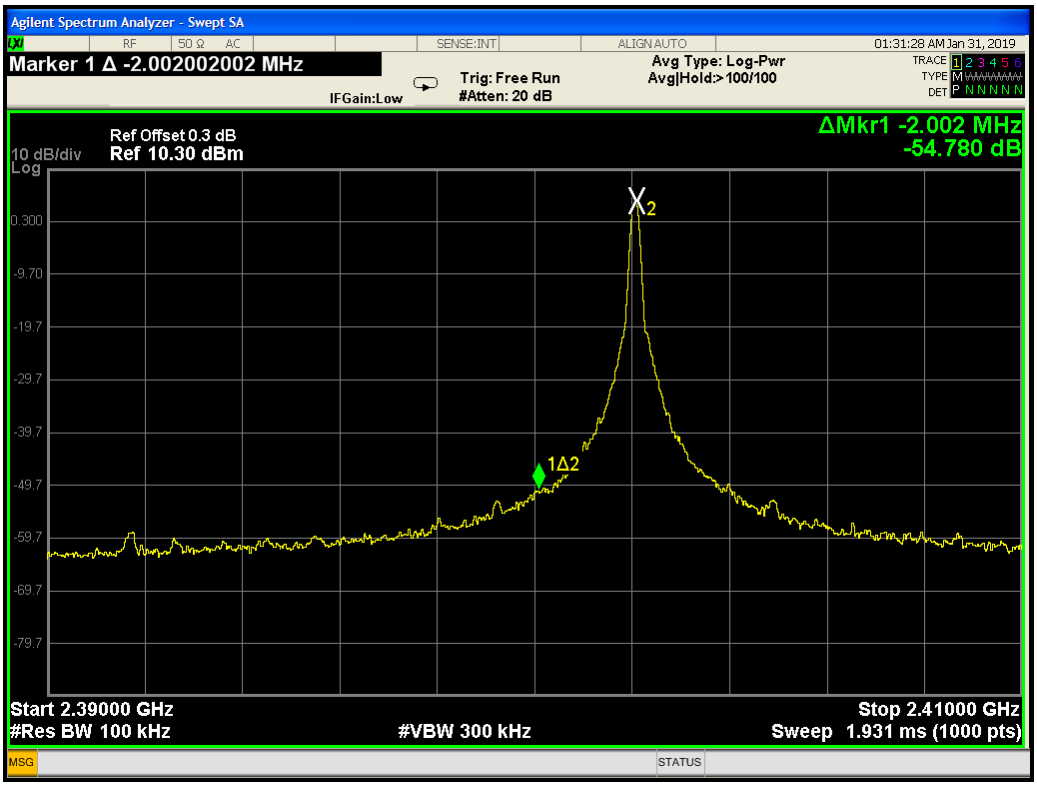




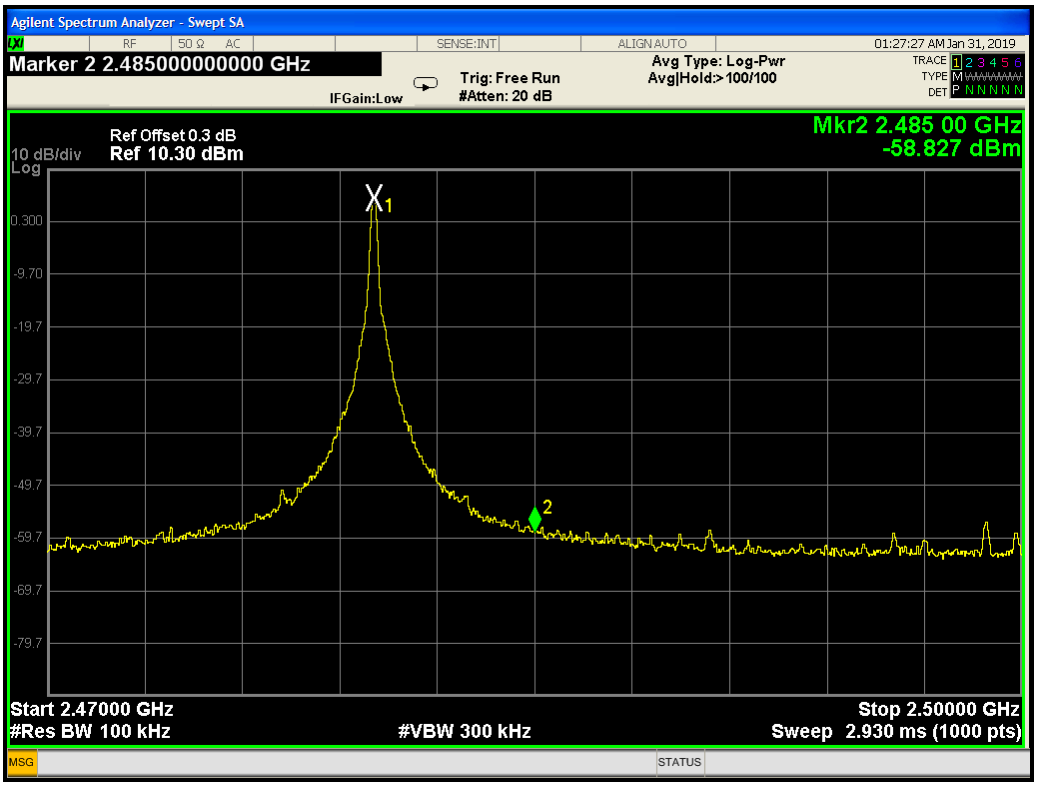
Conducted Spurious – Hight Channel

4.6	**Band-Edge Compliance**	
Method:	The measurements were made with transmitter set to transmit continuously with modulated signal at low and high channels.	
	Laboratory Ambient Temperature:	23°C
	Relative Humidity:	18%
	Atmospheric Pressure:	836.8 mbars
Reference Standard(s):	☒ ANSI C63.10:2013 ☒ FCC Part 15.247/RSS 247 ☐	**Measurement Point** ☒ Conducted ☐ Radiated
Frequency Range:	☒ 2402.0-2480.0 MHz	**Results**
Limit:	☒ >20dBc	Low Ch., 2402 MHz > 54dBc High Ch., 2480 MHz > 58dBc
Nominal Voltage:	☐ 120VAC ☒ 9VDC	
Test Personnel:	Yuriy Litvinov	**Date: 01/31/2019**

Note:	



Band Edge - Low Channel



Band Edge - High Channel

4.7	**Conducted Emissions Data**
Method:	The AMN was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the AMN. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on mains lines were made at the output of the AMN.
	All power was connected to the system through Artificial Mains Network (AMN). All tested telecommunications lines were connected to an Asymmetric Artificial Network (AAN) and conducted voltage measurements on telecommunications lines were made at the output of the ISN. Where an AAN was not appropriate or available measurements were made using a Capacitive Voltage Probe.

Test Verification: ☐	Laboratory Ambient Temperature:	
	Relative Humidity:	
	Atmospheric Pressure:	
Reference Standard(s):	☐ RSS GEN/FCC 15.207 ☐ ANSI C63.4:2014 ☐ ANSI C63.10:2013	**Measurement Point** ☐ Mains ☐ Telecommunication ports ☐
Nominal Voltage:	☐ 120VAC ☐ 230VAC ☐	
Test Personnel:		**Date:**

Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Average	Result	Comments
Limits - Class A – AC Mains				
0.15 to 0.50	79	66	**N/A**	AMN
0.50 to 30	73	60	**N/A**	AMN
Limits - Class B – AC Mains				
0.15 to 0.50	66 to 56	56 to 46	**N/A**	AMN
0.50 to 5	56	46	**N/A**	AMN
5 to 30	60	50	**N/A**	AMN

Modifications:	
Note:	

4.8	RF Exposure Compliance	
Reference Standard(s):	☒ IEEE Std 1528a ☒ RSS 102, Issue 5 ☒ KDB 447498 ☐ KDB	☐ MPE ☐ SAR Evaluation ☒ SAR Test Exclusion
Frequency Range:	☒ 2402-2480MHz	
Antenna Separation Distance:	>6.2mm	
Duty Cycle:	100 %	
Maximum Output power (EIRP):	5.7dBm (3.7 mW)	
SAR Test Exclusion Threshold for 100MHz – 6GHz		
FCC	10 mW (<5mm)	
RSS 102, Issue 5	4 mW (<5mm)	

5.0	Test Equipment				
Test Equipment Used					
Description	**Manufacturer**	**Model**	**Identifier**	**Last Cal. Date**	**Check**
Biconilog Antenna	Schaffner	CBL6112B	27491	10/20/2018	☒
Horn Antenna	A.H. Systems	SAS 571	1010	10/20/2018	☒
Loop Antenna	A.H. Systems	EHA-51B	1213E	10/20/2018	☐
Loop Antenna	EMCO	ALR25M	1011	10/20/2018	☐
Signal Analyzer	Agilent	N9000A	MY53031040	10/20/2018	☒
EMI Receiver	Agilent	E4448A	1530975	10/20/2018	☒
LISN	TESEQ	NNB51	1130	10/20/2018	☐
EMF Meter	NARDA	ELT400	1139	10/20/2018	☐
EMF E-field Probe	NARDA	Type 8.3 100KHz-3GHz	K-0014	10/20/2018	☐
EMF H-field Probe	NARDA	Type 12.1 300KHz-30MHz	AP-0004	10/20/2018	☐
Coaxial Cable	Insulated Wire	2803	CBL2039	10/212018	☒
EMC Software	ETS-Lindgren	TILE 7		10/20/2018	☒
Equipment Calibration Interval:		☒ 12 months		☐ 24 months	

6.0	Report revision history		
Revision Level	**Date**	**Report Number**	**Notes**
0	02/22/2019	RE1701014-1	Original Issue

Statement of Conformity

3M EMC Laboratory

Hardgoods Regulatory Engineering
Building 76-01-01
St. Paul, MN 55144-1000, USA

MANUFACTURER'S NAME:	**3M Company**
NAME OF EQUIPMENT:	**Comfort Grip Connected Hook**
MODEL NUMBER(S):	**2000217**
TEST REPORT NUMBER:	**RE 1701014-1**
DATE OF ISSUE:	**February 22, 2019**

Referring to the performance criteria and operating mode during the tests specified in this report the equipment complies with the essential requirements herein specified:

47 CFR Part 15 – Subpart C – Intentional Radiator	**47 CFR, FCC Part 15.247**
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices	**RSS 247, Issue 2, 2017**

Comments:

NVLAP TESTING
NVLAP Lab Code 200033-0

Yuriy Litvinov

Yuriy Litvinov
Lead EMC Engineer