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 Sensor Box Model(s): 8548924

Company Name: 3M Company

Address:

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

Report Number: RE1906154-1 Report Issue Date: September 18, 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



Page 2 of 25

Iter	n	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	DTS Bandwidth	6	
	4.2	Maximum Peak Conducted Output Power	8	
	4.3	Maximum Power Spectral Density level	9	
	4.4	Radiated Emissions in restricted band	10	
	4.5	Radiated Emissions in non-restricted band	18	
	4.6	DTS Band-edge Emissions Measurements	20	
	4.7	Conducted Emissions	22	
	4.8	RF Exposure Compliance	23	
5.0		Test Equipment	24	
6.0		Revision History	24	



Page 3 of 25

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 powered from automotive battery.
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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



Page 4 of 25

2.0 Equipment Description

3M

2.1	Equipment Under Test				
Description:		3M Active Safety Connected Sensor Box			
Model(s):		8548924			
Serial number:		N/A			
Contact:		Scott Brigham			
	Phone:	651 737 2827			
	3M Division:	Personal Safety			
Modifi	cations and Special Measures:	none			
Frequency Range:		2402.0-2480.0 MHz	<u>'</u>		
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	☐ Yes			
		Voltage:	☐ 120VAC	☐ 230VAC	
	Rated Power:	Phase:	☐ 1ph	☐ 3ph	□ Battery
	Rated Power:	Frequency:	☐ 50Hz	☐ 60Hz	
		Current:			
	Test Dates:	09/12-09/16/2019			
	Received Date:	09/12/2019			
	Pennisad Conditions	Poor	☐ Poor ☐ Good		
	Received Conditions:	☑ Prototype	☑ Prototype ☐ Production		



Page 5 of 25

3.0 EUT Configuration

3.1 System Configuration

No.	Product Type	Manufacturer	Model	Comments
1	Sensor Box PCB	3M	8548924	
2	DC Power Supply	PMC	BPA-200	

3.2 Input/Output Ports of EUT

No.	Description	Туре	Comments
1			
2			

3.3 Cables

No.	Description	Туре	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	

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.



Page 6 of 25

4.0 Test Conditions and Results

3M

4.1	DTS Bandwidth			
		Laboratory Ambient Temperature:	23°C	
		Relative Humidity:	48%	
		Atmospheric Pressure:	1011 mbars	
Referer	nce Standard(s):	☑ ANSI C63.10:2013☑ FCC Part 15.247/RSS 247	Measurement Point ☐ Conducted ☐ Radiated	
Fre	equency Range:	⊠ 2402.0-2480.0 MHz	RBW = 100KHz VBW ≥ 3 x RBW	
Nominal Voltage:		☐ 120VAC 🖾 12VDC		
	Test Personnel:	Yuriy Litvinov yang divinor	Date: 09/16/2019	

Frequency (MHz)	99% dB Bandwidth (KHz)	6 dB Bandwidth (KHz)	6dB OBW Limit (KHz)	Results
2402	1065	694.5	> 500	pass
2440	1068	691.6	> 500	pass
2480	1070	692.5	> 500	pass





OBW - Low Channel

OBW - Mid Channel



OBW - High Channel



4.2	Maximum Output	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:	48%				
		Atmospheric Pressure:	1011 mbars				
Refe	erence 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	Naulated at 3 meters				
	Antenna Gain:	1.1 dBi	Maximum Conducted Power (EIRP):				
	Limit:	30 dBm	-2.45 dBm				
	Nominal Voltage:	☐ 120VAC ☐ 12VDC					
Test Personnel:		Yuriy Litvinov Yuriy divinor	Date: 09/16/2017				

Note: EIRP (dBm) = Conducted Power (dBm) +Antenna Gain (dBi)= -3.5+1.1= -2.4dBm





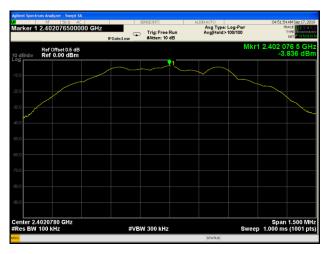
Low Channel



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:	48%				
		Atmospheric Pressure:	1011 mbars				
Refere	ence Standard(s):	☑ ANSI C63.10:2013☑ FCC Part 15.247/RSS 247☑ KDB 558074 D01	Measurement Point ☐ Conducted ☐ Radiated at 3 meters				
F	requency Range:	☑ 2402.0 – 2480.0 MHz	PSD Results				
	PSD Limit:	8 dBm	-3.5 dBm				
	Nominal Voltage:	☐ 120VAC ☐ 12VDC					
Test Personnel:		Yuriy Litvinov ywy dwino	Date: 09/16/2016				





PSD Low Channel

PSD Mid Channel



PSD High Channel

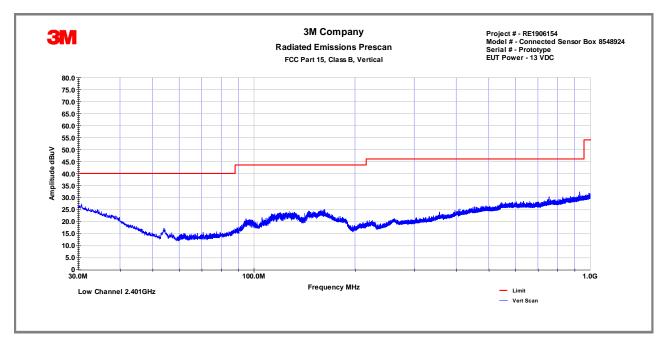


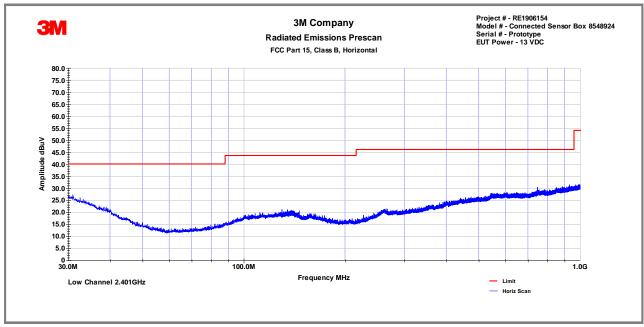
Page 10 of 25

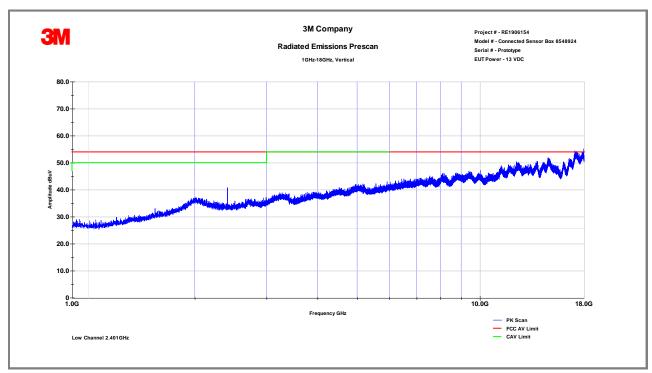


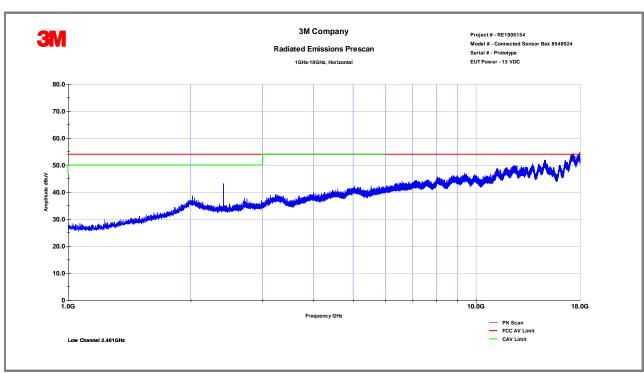
4.4	Radiated Emissions in r	estricted band					
Method:	Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4 standards. EUT was rotated through three orthogonal axes to determine which attitude (orientation) and arrangement produces the highest emission relative 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 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.						
	,	Laboratory	/ Ambient Tempera	iture:		23°C	
Test	t Verification: 🛚		Relative Hum	idity:		55%	
			Atmospheric Press	sure:		1011 mbar	'S
	Reference Standard(s):	☐ ANSI C63.4:20	2013:2013			3 Meters	
	Frequency Range:	☑ 30 MHz to 1 G☑ 1 GHz to 25 G					
	3VDC						
	Test Personnel:	Keith Schwartz KS			Date: 09/13/2019		
		Limits – 1	5.109, Class A				
Fr	requency (MHz)	Limit dB (µV/m)					
	equency (Wiriz)	Quasi-Peak	Average	Pe	eak	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 15.2	209			
	0.009-0.490		2400/F(KHz)	3	00	300	N/A
	0.490-1.705	24000/F(KHz)		3	30	30	N/A
	1.705-30	30		3	30	30	N/A
	30 to 88	40				3	pass
	88 to 216					3	pass
	216 to 960	46				3	pass
	Above 960		54			3	pass

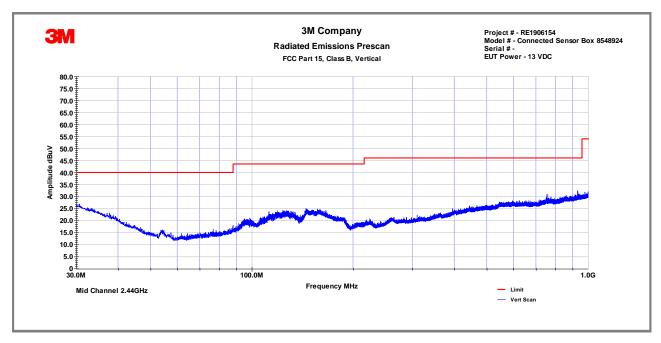
Modifications:	
	For emission in the restricted bands, the limit of 15.209 was used.
Note:	The lower limit applies at the transition frequency. An inverse proportionality factor of 20 dB per decade has been used to normalize the measured data to the specified distance for determining compliance.
	No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

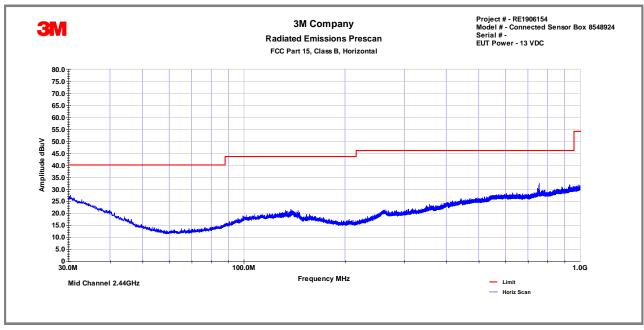


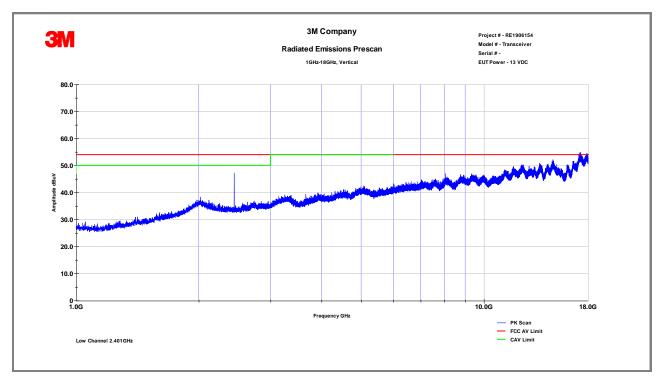


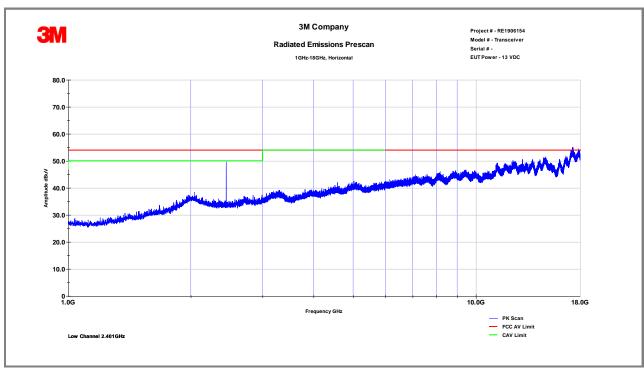


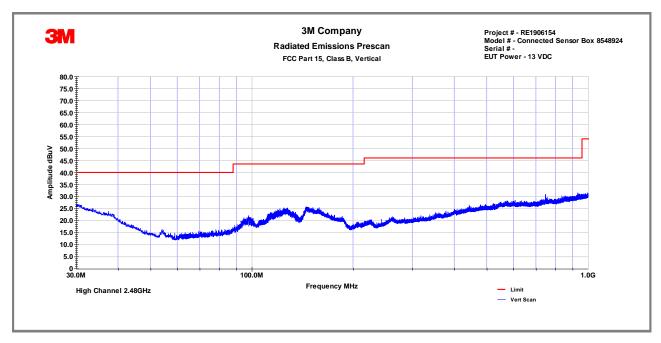


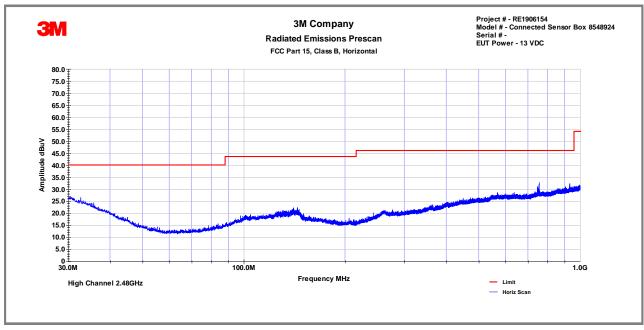


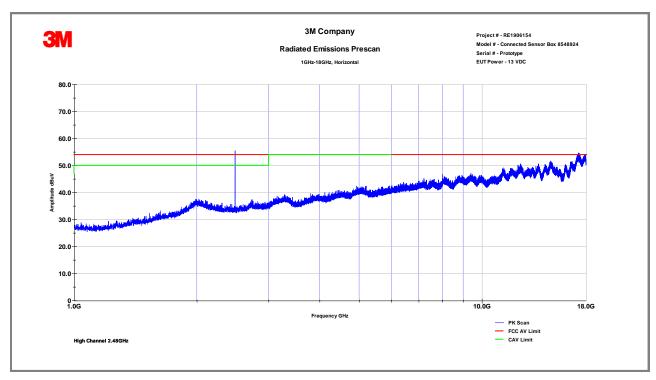


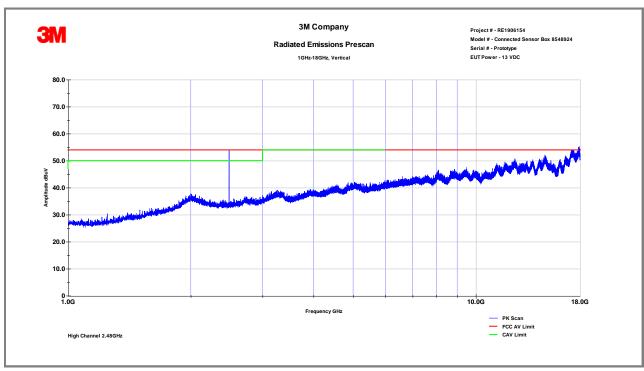














Pol	Frequency (MHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit	AVE Limit dBμV/m	PK Margin dB	AVG Margin dB
V	4803.87	49.54	41.6	-6.20	43.34	35.35	74.00	54.00	-30.66	-18.65
Н	4803.87	49.63	42.0	-6.20	43.43	35.81	74.00	54.00	-30.57	-18.19
V	7205.80	49.51	38.7	-3.01	46.50	35.71	74.00	54.00	-27.50	-18.29
Н	7205.80	49.06	39.3	-3.01	46.05	36.31	74.00	54.00	-27.95	-17.69
V	9607.73	48.10	36.8	-1.07	47.03	35.74	74.00	54.00	-26.97	-18.26
Н	9607.73	47.99	36.6	-1.07	46.92	35.50	74.00	54.00	-27.08	-18.50
	Net Reading (dBuV) = Reading (dBμV) + (Antenna with amp CF(dB)+Cable CF(dB))									
	Notes: Low Channel									

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Pol	Frequency (MHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit	AVE Limit	PK Margin dB	AVG Margin dB
V	4879.80	50.56	42.6	-5.39	45.17	37.22	74.00	54.00	-28.83	-16.78
Н	4879.80	50.29	42.4	-5.39	44.90	37.00	74.00	54.00	-29.10	-17.00
V	7319.70	48.76	38.7	-3.19	45.57	35.51	74.00	54.00	-28.43	-18.49
Н	7319.70	48.95	39.0	-3.19	45.76	35.80	74.00	54.00	-28.24	-18.20
V	9759.60	47.64	36.3	-1.34	46.30	34.95	74.00	54.00	-27.70	-19.05
Н	9759.60	47.78	36.2	-1.34	46.44	34.87	74.00	54.00	-27.56	-19.13
	Net Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB))									
Notes: Mid Channel										

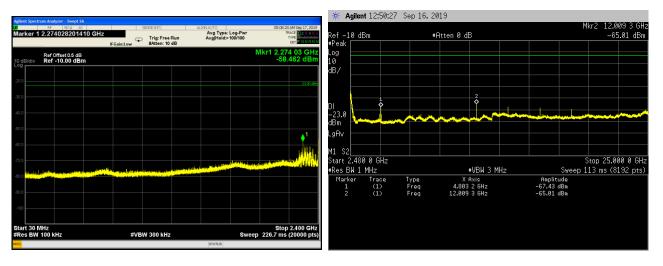
Pol	Frequency (MHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit dBµV/m	AVE Limit dBμV/m	PK Margin dB	AVG Margin dB
V	4959.13	49.73	40.4	-5.15	44.58	35.27	74.00	54.00	-29.42	-18.73
Н	4959.13	49.98	42.5	-5.15	44.83	37.39	74.00	54.00	-29.17	-16.61
V	7438.70	48.17	37.5	-2.60	45.57	34.86	74.00	54.00	-28.43	-19.14
Н	7438.70	48.17	38.3	-2.60	45.57	35.66	74.00	54.00	-28.43	-18.34
V	9918.27	48.17	36.6	-0.68	47.49	35.95	74.00	54.00	-26.51	-18.05
Н	9918.27	48.03	36.7	-0.68	47.35	35.97	74.00	54.00	-26.65	-18.03
	Net Reading (dBuV) = Reading (dB μ V) + (Antenna with amp CF(dB)+Cable CF(dB))									
	Notes:	es: High Channel								



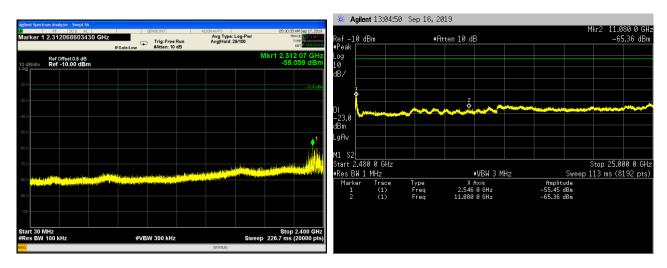
Report Number: RE1906154-1 Date: September 18, 2019

Page 18 of 25

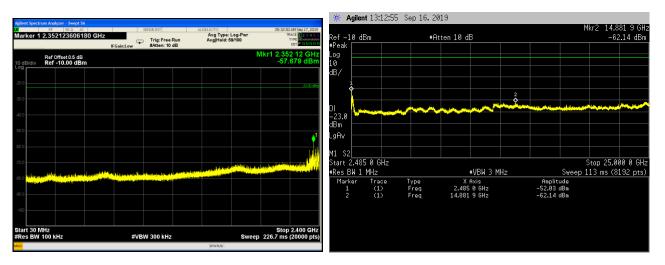
_								
4.5	Radiated Emiss	Radiated Emissions in non-restricted band						
Method:	The measurements	The measurements were made with transmitter set to transmit continuously low, medium and high channels.						
		Laboratory Ambient Temperature:	23°C					
		Relative Humidity:	48%					
		Atmospheric Pressure:	1011 mbars					
Reference Standard(s):		☑ ANSI C63.10:2013☑ FCC Part 15.247/RSS 247☐	Measurement Point ☑ Conducted ☐ Radiated					
Fre	equency Range:	⊠ 2402.0-2480.0 MHz						
PSD L	evel in 100KHz:	☑ -3.5 dBm	Results:					
	Limit:	☐ -23.5dBm (20dBc below Peak PSD level)	>48.5dBc					
N	lominal Voltage:	☐ 120VAC 🖾 12VDC						
Test Personnel:		Yuriy Litvinov Yuriy distinst	Date: 06/19/2019					
	Note:							



Conducted Spurious - Low Channel



Conducted Spurious – Mid Channel



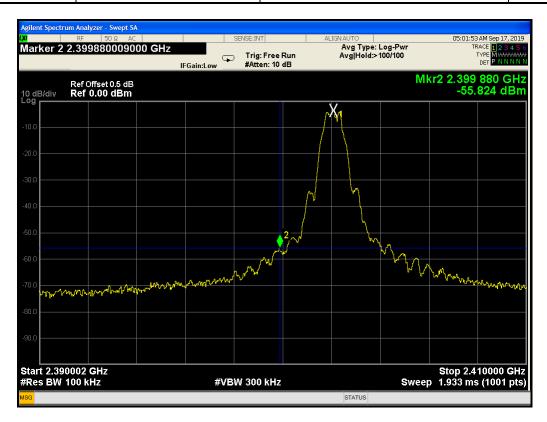
Conducted Spurious – Hight Channel



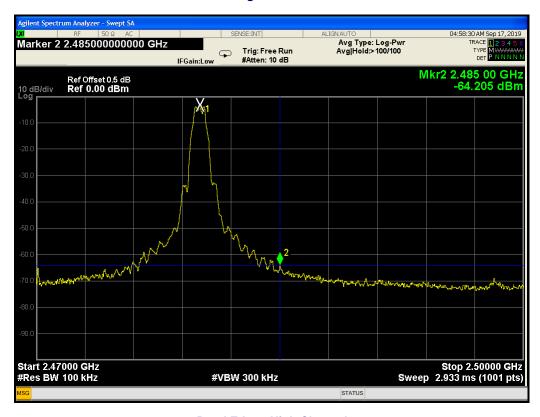
Report Number: RE1906154-1 Date: September 18, 2019

Page 20 of 25

4.6	Band-Edge Co	Band-Edge Compliance						
Method:	The measureme channels.	The measurements were made with transmitter set to transmit continuously with modulated signal at low and hig channels.						
		Laboratory Ambient Temperature:	23°C					
		Relative Humidity:	48%					
		Atmospheric Pressure:	1011 mbars					
Referenc	e Standard(s):	☑ ANSI C63.10:2013☑ FCC Part 15.247/RSS 247☐	Measurement Point ☐ Conducted ☐ Radiated					
Fred	quency Range:	⊠ 2402.0-2480.0 MHz	Results					
	Limit:	⊠ >20dBc	Low Ch., 2402 MHz > 52dBc High Ch., 2480 MHz > 61dBc					
No	minal Voltage:	☐ 120VAC 🖾 12VDC						
Test Personnel:		Yuriy Litvinov ymry divinos	Date: 09/16/2019					
N	lote:							



Band Edge - Low Channel



Band Edge - High Channel



Note:

Report Number: RE1906154-1 Date: September 18, 2019

Page 22 of 25

4.7	Conducte	Conducted Emissions Data							
Made a	was betwee 0.8 m from	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.							
Method:	connected were made	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.							
			Laboratory Ambient	Temperature:					
	Test Verifi	ication:	Rela	tive Humidity:					
			Atmosph	eric 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:					
			Limits - Class A - AC Ma	ains					
Frequen	cy (MHz)		Limit d	Β (μV)					
rrequen	Cy (IVII IZ)	Quasi-Peak	Average	Result	Comments				
0.15 to	o 0.50	79	66	N/A	AMN				
0.50	to 30	73	60	N/A	AMN				
	Limits - Class B - AC Mains								
0.15 to	o 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				
Modifie	eations								



Report Number: RE1906154-1 Date: September 18, 2019

Page 23 of 25

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:	>20mm		
	Duty Cycle:	100 %		
М	aximum Output power (EIRP):	-2.4dBm (0.6mW)		
	SAR Test	Exclusion Threshold for 100MHz – 6GHz		
	FCC	10 mW (<5mm)		
	RSS 102, Issue 5	4 mW (<5mm)		



Report Number: RE1906154-1 Date: September 18, 2019

Page 24 of 25

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			
EMI Receiver	Rohde & Schwarz	ESW26	101412	03/11/2019			
Signal Analyzer	Agilent	N9000A	MY53031040	10/20/2018	\boxtimes		
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:				24 months			

6.0	Report revision history						
Revisio	n Level	Date	Report Number	Notes			
	0	09/18/2019	RE1906154-1	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: DBI Sala Nano-Lok Connected Sensor Box

MODEL NUMBER(S): 8548924
TEST REPORT NUMBER: RE1906154-1
DATE OF ISSUE: September 18, 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:

TESTING NVLAP Lab Code 200033-0

Yuriy Litvinov Lead EMC Engineer

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