

EMC TEST REPORT



NVLAP Lab Code 200033-0

Standard(s):

**47 CFR FCC Parts 15.107, 15.109 and 15.249
RSS 210, Issue 9, 2016
ICES-003, Issue 6, 2016**

**FCC ID: DGF-SOSDEM550USB
IC: 458A-EM550USB**

**Product: 3M USB Dongle for Ergonomic Mouse
Models: EM550USB**

**Company Name:
3M Company**

**Address:
3M Center, Building 280
St. Paul, MN 55144-1000**

**Report Number: RE1706035-2
Report Issue Date: January 22, 2018**

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.

	Standard	Requirement – Test	Result	Comments
4.1	Part 15.207/RSS-Gen	Conducted Emissions	pass	
4.2	Part 15.249 (a)&(d)/ RSS 210, Annex B.10	Field strength of fundamental and Band-edge test	pass	
4.3	Part 15.249(a)/15.209 RSS 210, Annex B.10	Field strength of harmonics and Spurious Emissions	pass	
4.4	Part 15.215 (c)/ RSS Gen	Occupied Bandwidth	pass	

Note:	
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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:	USB Dongle receiver for 3M wireless optical mouse with ergonomic design.			
Model(s):	EM550USB			
Serial number:	N/A			
Client Contact:	Susan Butzer			
Phone:	1-651-733-0755			
3M Division:	Stationery and Office Supplies			
Modifications and Special Measures:	None			
Frequency Range:	2405-2477 MHz			
Channel No.:	16			
Modulation Type:	GFSK			
Maximum Field Strength:	96.80 dB μ V/m at 3 meters			
Antenna Type:	PCB Antenna			
Test Deviations or Exclusions	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No		
Rated Power:	Voltage:	<input checked="" type="checkbox"/> 120VAC	<input type="checkbox"/> 230VAC	<input type="checkbox"/> 5.0 VDC
	Phase:	<input type="checkbox"/> 1ph	<input type="checkbox"/> 3ph	<input type="checkbox"/> Battery
	Frequency:	<input type="checkbox"/> 50Hz	<input type="checkbox"/> 60Hz	
	Current:			
Test Dates:	09/27-10/12/2017			
Received Date:	09/18/2017			
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	Laptop Computer	HP	Elitebook 840	Support Equipment
2	Ergonomic Mouse	3M	EM550GPL	Support Equipment
3				

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	PC Connection to Optical mouse
2	

3.6 Exercising of EUT and Interfaces

No.	Mode of Operation
1	Transmitting at lowest, middle and highest channels of operation with un-modulated carrier
2	Device programming using Areson mouse tool utility software for continuous transmission at maximum rated RF output power and Duty Cycle.

**4.0 Test Conditions and Results**

4.1	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: <input checked="" type="checkbox"/>	Laboratory Ambient Temperature:		21°C	
	Relative Humidity:		45%	
	Atmospheric Pressure:		836.8 mbars	
Reference Standard:	<input checked="" type="checkbox"/> RSS GEN/FCC 15.207 <input type="checkbox"/> ANSI C63.4:2014 <input checked="" type="checkbox"/> ANSI C63.10:2013		Measurement Point <input checked="" type="checkbox"/> Mains <input type="checkbox"/> Telecommunication ports <input type="checkbox"/>	
Nominal Voltage:	<input checked="" type="checkbox"/> 120VAC <input type="checkbox"/>			
Test Personnel:	Clay Huff <i>C.H</i>		Date: 10/04/2017	
Limits - Class A – AC Mains				
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Average	Result	Comments
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	pass	AMN
0.50 to 5	56	46	pass	AMN
5 to 30	60	50	pass	AMN

Modifications:	
Note:	USB Dongle was tested via a Laptop USB connection.

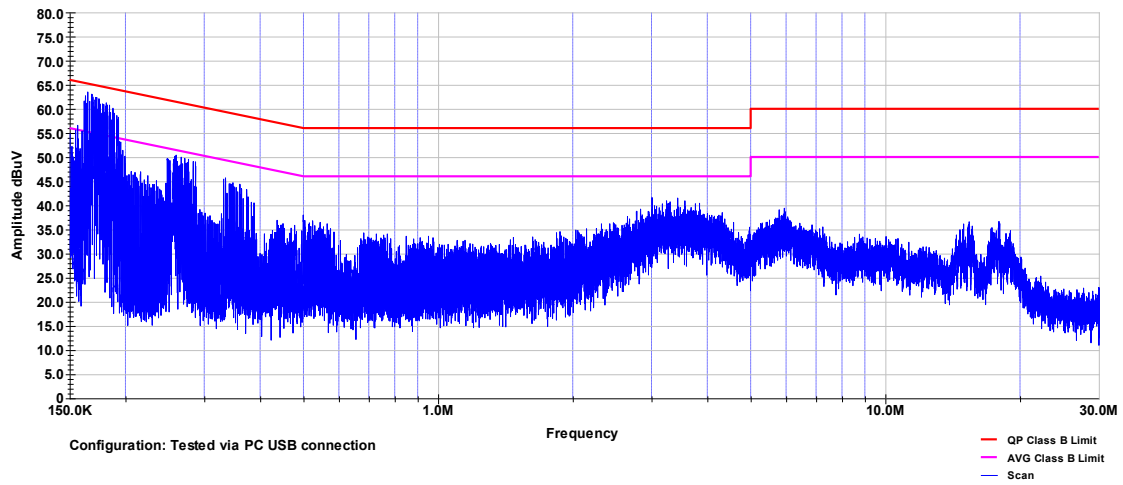


Frequency (MHz)	QP Line 1 dB (μ V)	AVG Line 1 dB (μ V)	QP Limit dB (μ V)	AVG Limit dB (μ V)	QP Margin dB	AVG Margin dB
0.164	59.04	40.29	65.26	55.26	-6.22	-14.97
0.166	59.96	43.16	65.16	55.16	-5.2	-12
0.262	46.11	44.78	61.36	51.36	-15.25	-6.58
0.33	41.02	22.87	59.45	49.45	-18.43	-26.58
4.113	33.58	26.09	56	46	-22.42	-19.91
14.479	29.8	21.06	60	50	-30.2	-28.94
Frequency (MHz)	QP Line 2 dB (μ V)	AVG Line 2 dB (μ V)	QP Limit dB (μ V)	AVG Limit dB (μ V)	QP Margin dB	AVG Margin dB
0.163	56.02	36.41	65.31	55.31	-9.29	-18.9
0.166	58.23	40.77	65.18	55.18	-6.95	-14.42
0.263	45.86	31.56	61.34	51.34	-15.48	-19.78
0.332	41.02	23.07	59.4	49.4	-18.38	-26.34
4.114	33.32	25.22	56	46	-22.68	-20.78
14.591	30.68	23.25	60	50	-29.32	-26.75
Voltage		<input checked="" type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input type="checkbox"/>				
Notes						



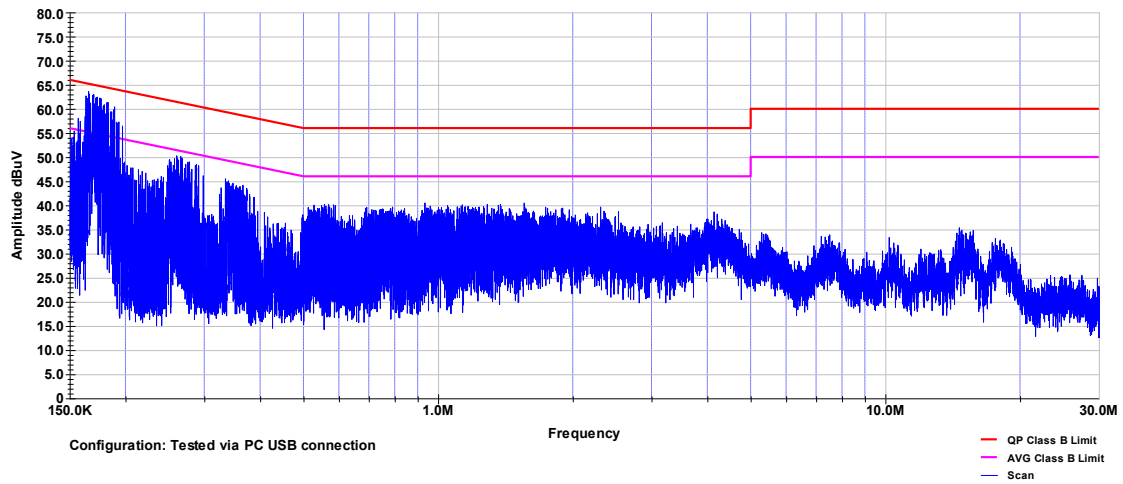
3M Company
Conducted Emissions
CISPR32_FCC Part 15, Class B, Line 2

RE Project # - RE1706035
Model # - EM 500/Dongle
Serial # - N/A
EUT Power - 120VAC/60Hz



3M Company
Conducted Emissions
CISPR32_FCC Part 15, Class B, Line 1

RE Project # - RE1706035
Model # - EM 500/Dongle
Serial # - N/A
EUT Power - 120VAC/60Hz





4.2		Field strength of fundamental and Band-edge test	
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:	21°C
		Relative Humidity:	45%
		Atmospheric Pressure:	836.8 mbars
Reference Standard:		<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.249/RSS 210 <input type="checkbox"/>	Measurement Point <input type="checkbox"/> Conducted <input checked="" type="checkbox"/> Radiated at 3 meters
Frequency Range:		<input checked="" type="checkbox"/> 2405 – 2477 MHz	
Antenna Gain:		N/A	
Limit	Average:	94 dBµV/m	70.60 dBµV/m
	Peak:	114 dBµV/m	96.80 dBµV/m
Nominal Voltage:		<input checked="" type="checkbox"/> 120VAC <input type="checkbox"/> 5 VDC	
Test Personnel:		Clay Huff <i>C.H</i>	Date: 01/18/2018

Modifications:	
Note:	USB Dongle was tested via a Laptop USB connection.

PoI	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
H	2405.00	50.20	31.20	32.30	82.50	63.50	114.00	94.00	-31.50	-30.50
V	2405.00	64.50	30.50	32.30	96.80	62.80	114.00	94.00	-17.20	-31.20
V	2442.00	63.20	37.30	32.30	95.50	69.60	114.00	94.00	-18.50	-24.40
H	2442.00	54.30	38.30	32.30	86.60	70.60	114.00	94.00	-27.40	-23.40
H	2477.00	63.10	30.20	32.30	95.40	62.50	114.00	94.00	-18.60	-31.50
V	2477.00	62.30	33.50	32.30	94.60	65.80	114.00	94.00	-19.40	-28.20
Band-Edge test										
H	2390.00	22.10	12.80	32.30	54.40	45.10	74.00	54.00	-19.60	-8.90
V	2390.00	22.30	13.20	32.30	54.60	45.50	74.00	54.00	-19.40	-8.50
H	2483.50	23.100	13.00	32.90	56.00	45.90	74.00	54.00	-18.00	-8.10
V	2483.50	23.000	13.10	32.90	55.90	46.00	74.00	54.00	-18.10	-8.00
Notes		Net Peak (dBuV) = Peak (dBµV)+Total CF (dBm) (Antenna CF(dB)+Cable CF(dB) – Amp Gain(dB)) Average readings obtained with the 10Hz VBW								



4.3		Spurious Radiated Emissions Data			
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 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:	35%			
	Atmospheric Pressure:	836.8 mbars			
Reference Standard:	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.249/RSS 210 <input checked="" type="checkbox"/> FCC Part 15.209			Measurement Distance	
				<input checked="" type="checkbox"/> 3 Meters <input type="checkbox"/>	
Frequency Range:	<input checked="" type="checkbox"/> 30 MHz to 1 GHz <input checked="" type="checkbox"/> 1 GHz to 26 GHz				
Nominal Voltage:	<input checked="" type="checkbox"/> 120VAC <input type="checkbox"/>				
Test Personnel:	Clay Huff <i>C. H</i>			Date: 10/03//2017	
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:	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 spurious emissions were detected in the frequency range above 10GHz.

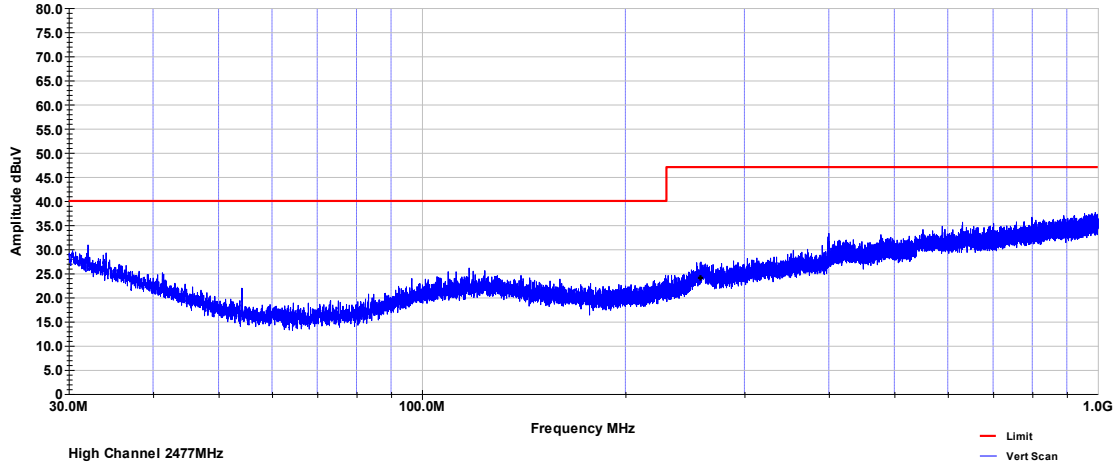


Frequency (MHz)	Pol.	QP Reading dB μ V/m	Total CF dB	Net at 3 m dB μ V/m	Limit (dB μ V/m)	Margin dB
32.276	H	3.5	22	25.5	40	-14.5
54.07	V	9.6	11.6	21.1	40	-18.9
117.142	V	3.6	17	20.6	43.5	-22.9
258.133	H	4	18.6	22.6	46	-23.4
399.718	V	4.9	21.3	26.1	46	-19.9
499.71	H	4.4	23.1	27.6	46	-18.5
Notes:	Net Peak (dB μ V) = Peak (dB μ V)+Total CF (dBm) (Antenna CF(dB)+Cable CF(dB) – Amp Gain(dB)) Measurements from 30 to 1000 MHz were performed at the High Channel as a worst case.					



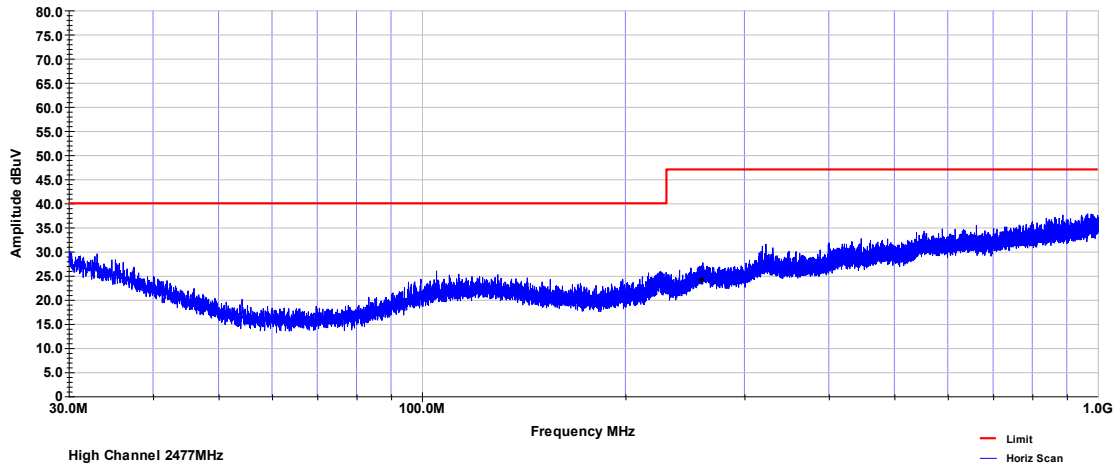
3M Company
Radiated Emissions Prescan
FCC Part 15, Class B, Vertical

RE Project # - RE1706035
Model # - EM550GPL/EM550GPS
Serial # -
EUT Power - USB



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

RE Project # - RE1706035
Model # - EM550GPL/EM550GPS
Serial # -
EUT Power - USB





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 μ V/m	AVG Margin dB
H	3991.00	38.20	30.00	-8.00	30.20	22.00	74.00	54.00	-43.80	-32.00
V	3991.00	38.20	30.30	-8.00	30.20	22.30	74.00	54.00	-43.80	-31.70
V	4810.00	53.00	51.30	-4.30	48.70	47.00	74.00	54.00	-25.30	-7.00
H	4810.00	59.80	57.90	-4.30	55.50	53.60	74.00	54.00	-18.50	-0.40
V	9620.00	39.80	30.20	2.30	42.10	32.50	74.00	54.00	-31.90	-21.50
H	9620.00	40.30	30.20	2.30	42.60	32.50	74.00	54.00	-31.40	-21.50
Notes	Net Peak (dBuV) = Peak (dB μ V)+Total CF (dBm) (Antenna CF(dB)+Cable CF(dB) – Amp Gain(dB))									
	Low Channel. Average readings obtained with the 10Hz VBW									

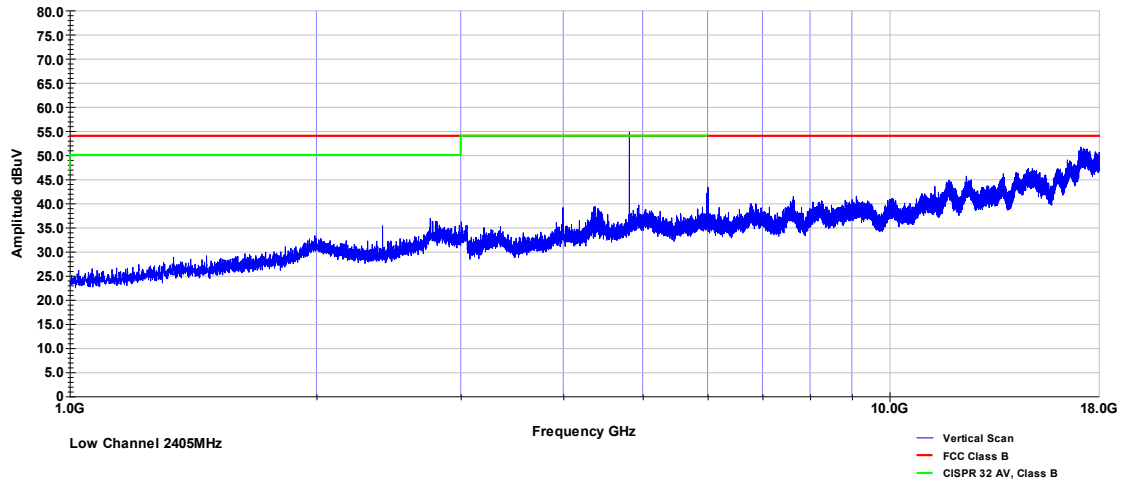
Pol	Frequency (MHz)	Peak dB μ V/m	AVG dB μ V/m	Total CF dB	Net Peak dB μ V/m	Net AVE dB μ V/m	PK Limit dB μ V/m.	AVE Limit dB μ V/m	PK Margin dB μ V/m	AVG Margin dB
H	4884.00	52.50	50.20	-8.00	44.50	42.20	74.00	54.00	-29.50	-11.80
V	4884.00	57.40	50.80	-8.00	49.40	42.80	74.00	54.00	-24.60	-11.20
V	7326.00	41.20	29.80	-4.30	36.90	25.50	74.00	54.00	-37.10	-28.50
H	7326.00	41.70	31.20	-4.30	37.40	26.90	74.00	54.00	-36.60	-27.10
H	9768.00	40.50	30.50	2.30	42.80	32.80	74.00	54.00	-31.20	-21.20
V	9768.00	41.20	30.60	2.30	43.50	32.90	74.00	54.00	-30.50	-21.10
Notes	Net Peak (dBuV) = Peak (dB μ V)+Total CF (dBm) (Antenna CF(dB)+Cable CF(dB) – Amp Gain(dB))									
	Mid Channel. Average readings obtained with the 10Hz VBW									

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 μ V/m	AVG Margin dB
V	4954.00	52.70	50.20	-8.00	44.70	42.20	74.00	54.00	-29.30	-11.80
H	4954.00	55.60	52.40	-8.00	47.60	44.40	74.00	54.00	-26.40	-9.60
V	7431.00	41.20	30.50	-4.30	36.90	26.20	74.00	54.00	-37.10	-27.80
H	7431.00	41.40	31.40	-4.30	37.10	27.10	74.00	54.00	-36.90	-26.90
V	9908.00	40.30	30.40	2.30	42.60	32.70	74.00	54.00	-31.40	-21.30
H	9908.00	41.70	30.70	2.30	44.00	33.00	74.00	54.00	-30.00	-21.00
Notes	Net Peak (dBuV) = Peak (dB μ V)+Total CF (dBm) (Antenna CF(dB)+Cable CF(dB) – Amp Gain(dB))									
	High Channel. Average readings obtained with the 10Hz VBW									



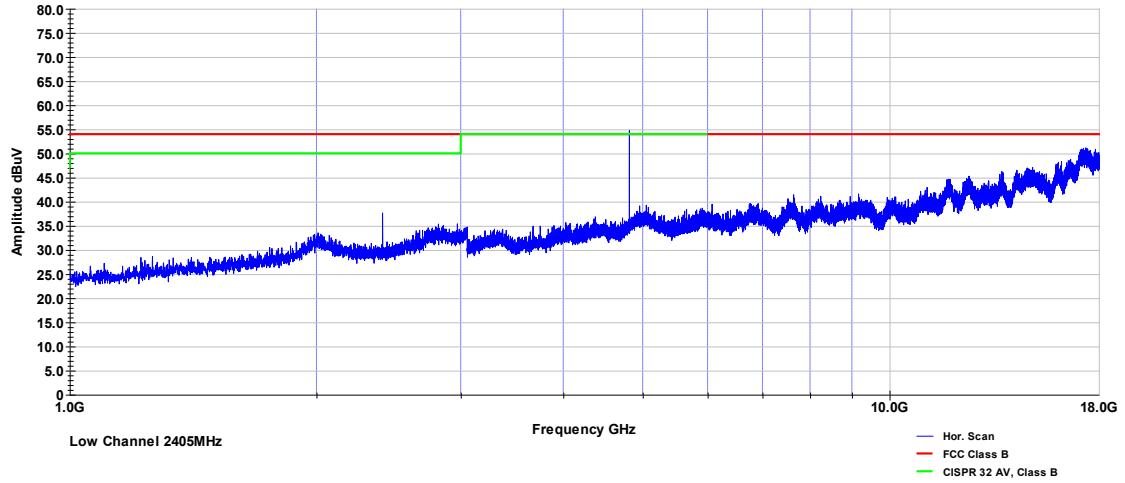
3M Company
Radiated Emissions Prescan
FCC Part 15 1GHz-18GHz, Vertical

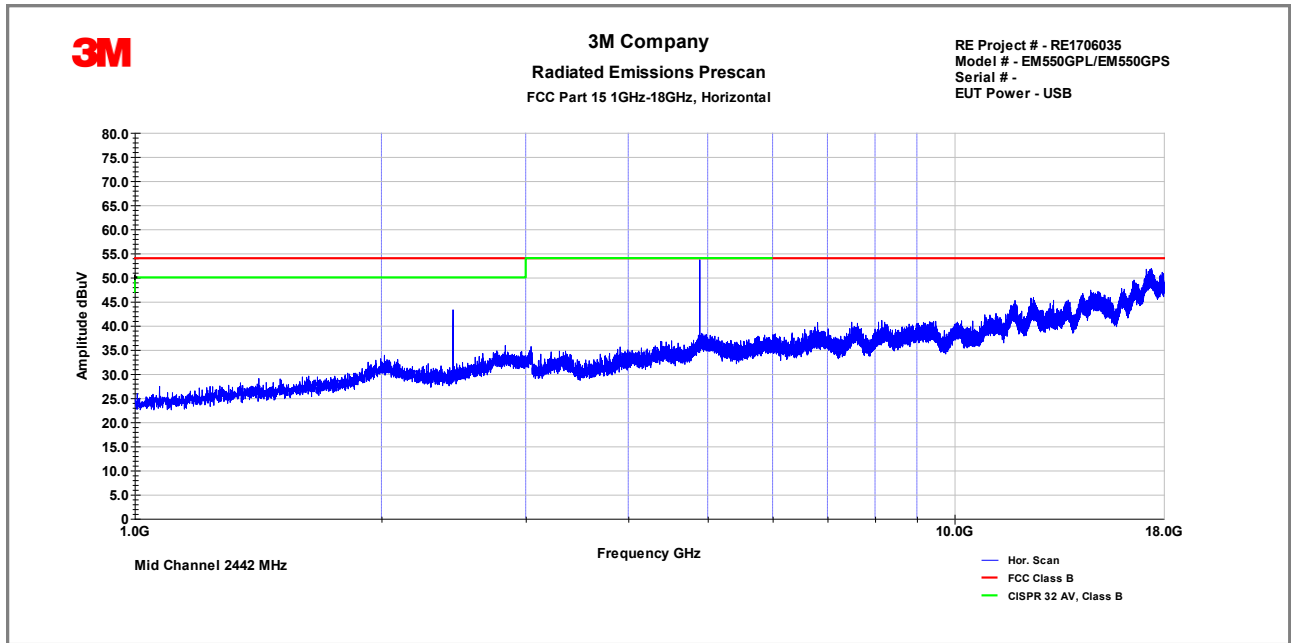
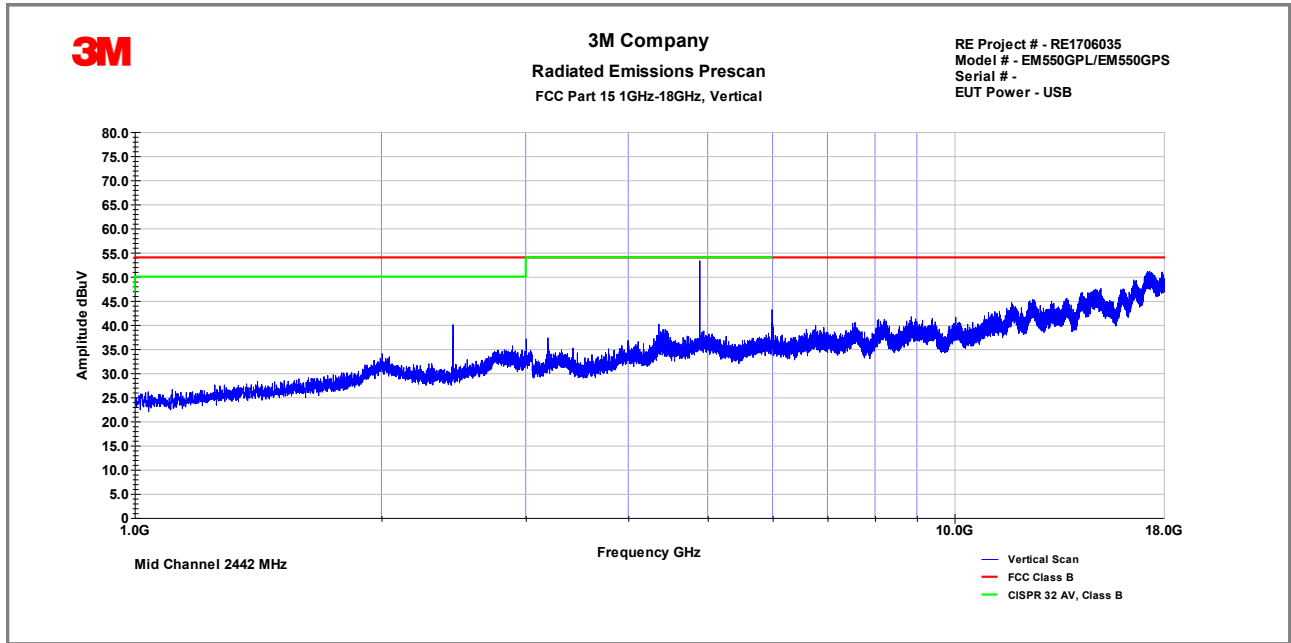
RE Project # - RE1706035
Model # - EM550GPL/EM550GPS
Serial # -
EUT Power - USB

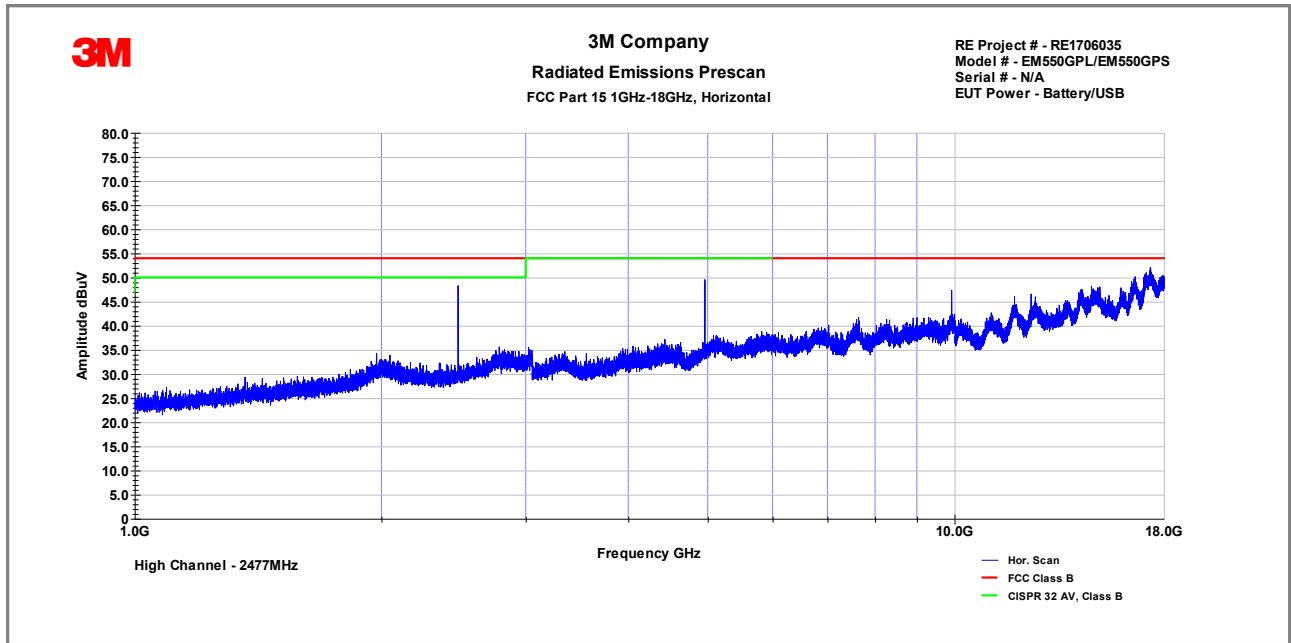
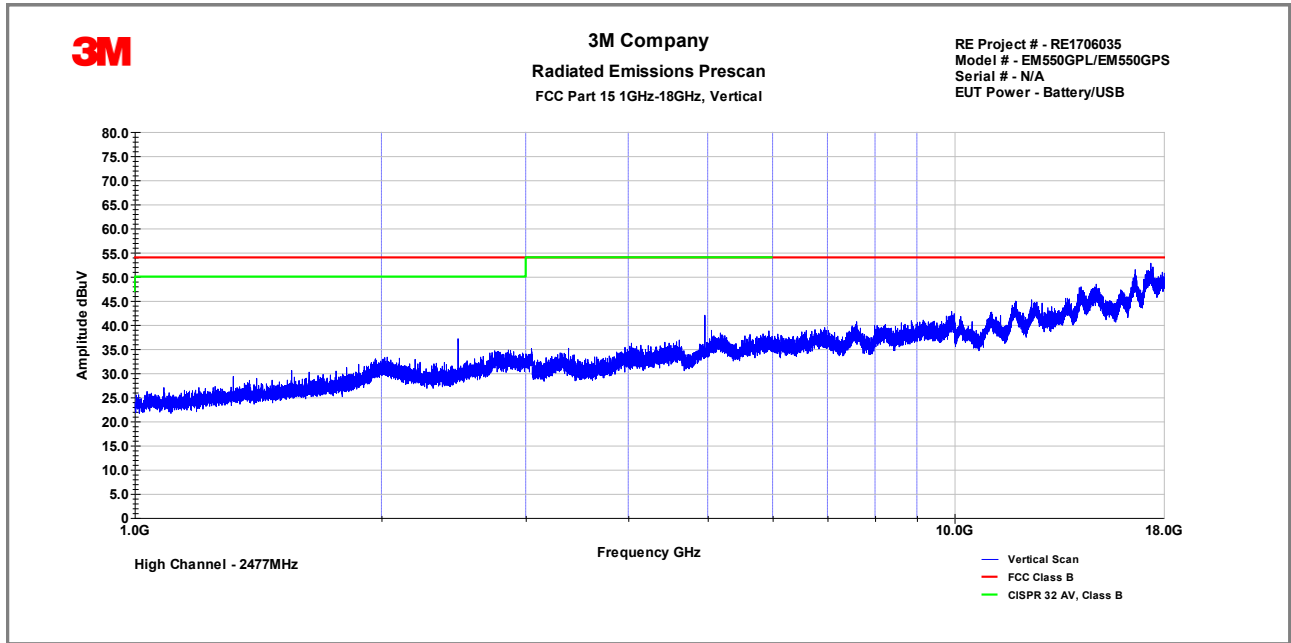


3M Company
Radiated Emissions Prescan
FCC Part 15 1GHz-18GHz, Horizontal

RE Project # - RE1706035
Model # - EM550GPL/EM550GPS
Serial # -
EUT Power - USB

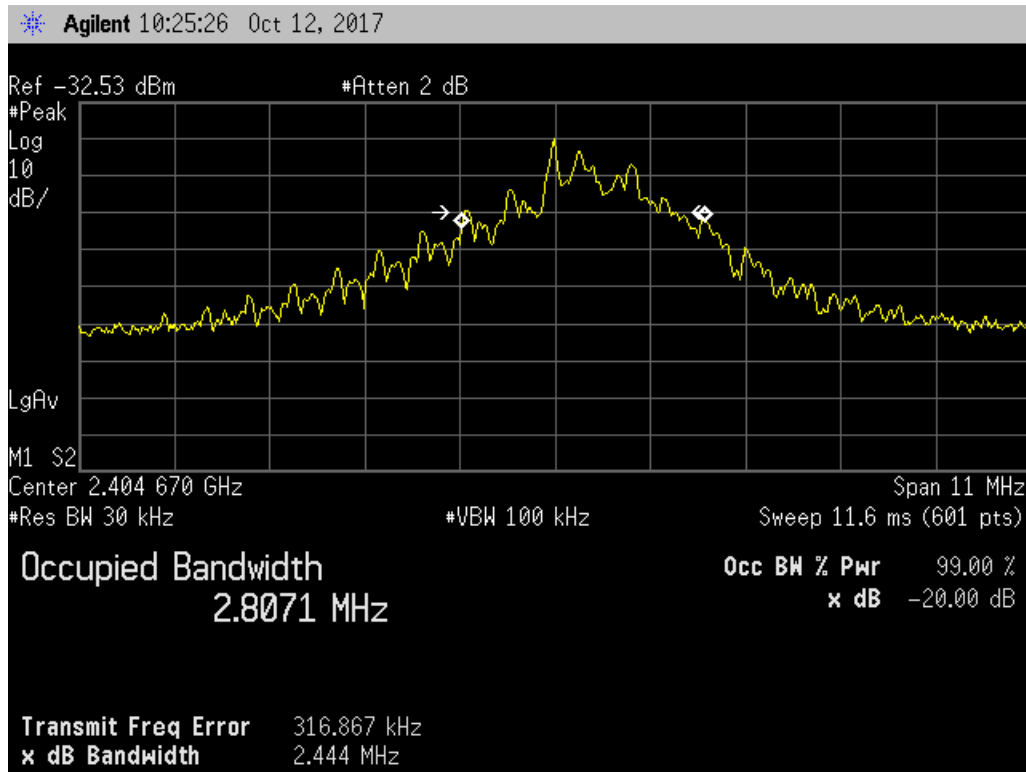




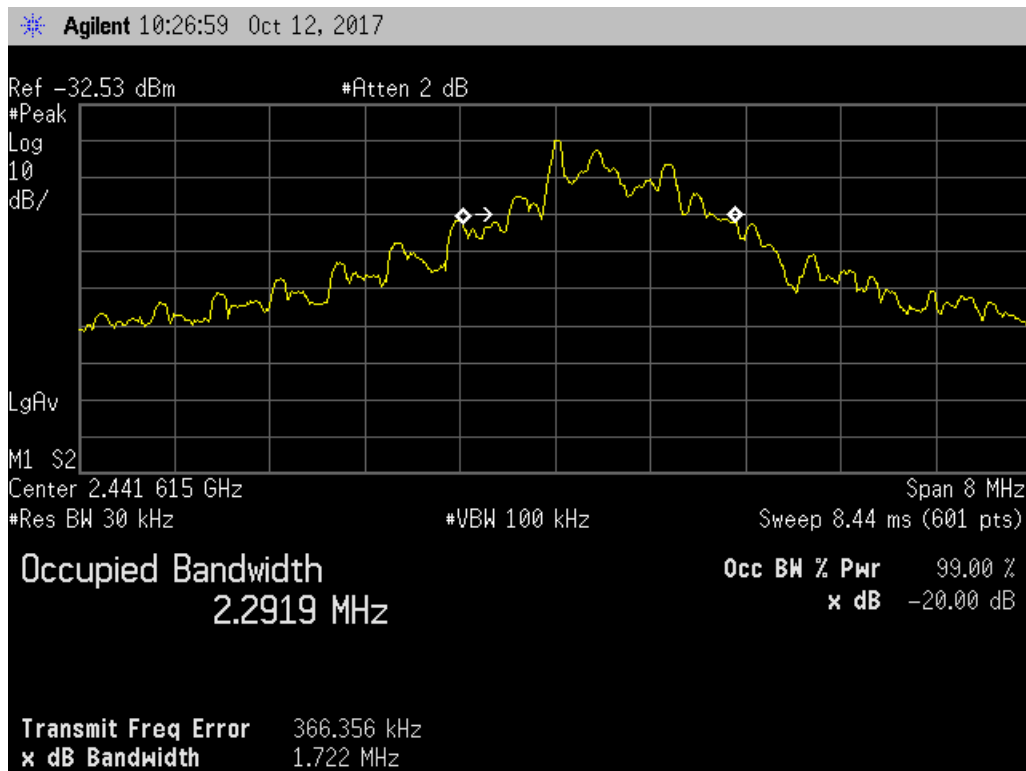


4.4	Occupied Bandwidth	
Method:	The 20dB bandwidth was measured with a spectrum analyzer connected via Loop antenna placed near the EUT while the EUT is operating in transmissions mode	
	Laboratory Ambient Temperature:	21°C
	Relative Humidity:	45%
Reference Standard:	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.249/RSS 210	Measurement Point <input type="checkbox"/> Conducted <input checked="" type="checkbox"/> Radiated
Frequency Range:	<input checked="" type="checkbox"/> 2405.0-2477.0 MHz	RBW ≥ 1% of the 20 dB bandwidth VBW ≥ RBW
Nominal Voltage:	<input checked="" type="checkbox"/> 120VAC <input type="checkbox"/> 5.0 VDC	
Test Personnel:	Clay Huff <i>C.H</i>	Date: 10/12/2017

Frequency (MHz)	20 dB Bandwidth (KHz)	99% Bandwidth (KHz)
2405	2444	2807
2442	1722	2291
2477	1419	1948



OBW – Low Channel



OBW – Mid Channel



OBW – High Channel



5.0

Test Equipment

Test Equipment Used

Description	Manufacturer	Model	Identifier	Last Cal. Date	Check
Biconilog Antenna	Schaffner	CBL6112B	27491	10/21/2017	<input checked="" type="checkbox"/>
Horn Antenna	AH Systems	SAS 571	1010	10/21/2017	<input checked="" type="checkbox"/>
Coaxial Cable	Insulated Wire	2803	CBL2039	10/21/2017	<input checked="" type="checkbox"/>
Loop Antenna	EMCO	ALR25M	1011	10/21/2017	<input type="checkbox"/>
EMI Receiver	Rohde & Schwarz	ESIB 40	100235	10/21/2017	<input checked="" type="checkbox"/>
EMI Receiver	Agilent	E4448A	1530975	10/21/2017	<input checked="" type="checkbox"/>
LISN	TESEQ	NNB51	1130	10/21/2017	<input checked="" type="checkbox"/>
EMC Software	ETS-Lindgren	TILE 7			<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	01/22/2018	RE1706035-2	Original Issue

Certificate of Conformity

3M EMC Laboratory

Hardgoods Regulatory Engineering

Building 76-01-01

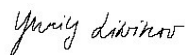
St. Paul, MN 55144-1000, USA

MANUFACTURER'S NAME:	3M Company
NAME OF EQUIPMENT:	USB Dongle for Ergonomic Mouse
MODEL NUMBER(S):	EM550USB
TEST REPORT NUMBER:	RE 1706035-2
DATE OF ISSUE:	January 22, 2018

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	FCC Parts 15.249, 15.107 and 15.109
License-Exempt Radio Apparatus: Category I Equipment	RSS 210, Issue 9, 2016
Information Technology Equipment (Including Digital Apparatus) — Limits and Methods of Measurement	ICES-003, Issue 6, 2016

Comments:



Yuriy Litvinov
Lead EMC Engineer