

# EMC TEST REPORT



47 CFR FCC Part 15.225,  
RSS 210, Issue 9, 2016,  
ICES 003, Issue 6, 2016

FCC ID:DGFPSDVC51  
IC:458A-PSDVC51

**Product:** 3M™ SCOTT™ Vision C5 Facepiece with RDI

**Model:** Vision C5 RDI

**Company Name:**  
3M Company

**Address:**  
Fire & SCBA Solutions  
4320 Goldmine Road, Monroe, NC 28110

**Report Number:** RE1904075-3  
**Report Issue Date:** April 24, 2020

**Report Prepared by:**

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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	Part 15.207/ RSS-Gen	Conducted Emissions	<b>N/A</b>	See note below
4.2	Part 15.225(d)/ RSS-210 A2.6(d)	Radiated Emissions outside of the specified band	<b>pass</b>	
4.3	Part 2.1049/RSS-Gen	Occupied Bandwidth	<b>pass</b>	
4.4	Part 15.225(a)(b)(c)/ RSS210 A2.6	In Band Radiated Spurious Emissions	<b>pass</b>	
4.5	15.225(e)/RSS210	Frequency Stability	<b>pass</b>	
4.6	15.209/15.247/RSS- Gen, 8.9	DTS - Radiated Emissions in restricted band	<b>pass</b>	BT module Verification. See note below.
4.7	2/1093/RSS102	RF Exposure Evaluation	<b>pass</b>	

<b>Note:</b>	Device is battery operated. Contains Cambridge Executive Limited, FCC ID:SSSBC127-X/IC:11012A-BC127 certified dual mode Bluetooth module 4.0
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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

<b>2.1</b>	<b>Equipment Under Test</b>			
<b>Description:</b>	3M™ Hands-free Sight Mask for Firefighters or First Responders with Bluetooth communications.			
<b>Model(s):</b>	Vision C5 RDI			
<b>Serial number:</b>	N/A			
<b>Contact:</b>	Klaus Wilkens, Product Responsibility Liaison			
<b>Phone:</b>	1-704-291-8395			
<b>3M Division:</b>	Personal Safety			
<b>Modifications and Special Measures:</b>	N/A			
<b>Frequency Range:</b>	13.56MHz NFC	2402-2480MHz BLE		
<b>Channel No.:</b>	1	BLE-40, BT_EDR - 79		
<b>Modulation Type:</b>	ASK	GFSK, π/4-DQPSK and 8DPSK		
<b>Maximum Output Power:</b>	N/A	5.14mW (7dBm)		
<b>Antenna Type:</b>	Internal PCB Loop Antenna	Ceramic PCB Antenna		
<b>EUT Highest Internal Frequency (F<sub>x</sub>):</b>	<24MHz			
<b>Test Deviations or Exclusions</b>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No		
<b>Rated Power:</b>	<b>Voltage:</b>	<input type="checkbox"/> 120VAC	<input type="checkbox"/> 230VAC	<input checked="" type="checkbox"/> 3.6 VDC
	<b>Phase:</b>	<input type="checkbox"/> 1ph	<input type="checkbox"/> 3ph	<input checked="" type="checkbox"/> Li-Ion Battery
	<b>Frequency:</b>	<input type="checkbox"/> 50Hz	<input type="checkbox"/> 60Hz	
	<b>Current:</b>			
<b>Test Dates:</b>	04/16-04/20/2019			
<b>Received Date:</b>	04/13/2019			
<b>Received Conditions:</b>	<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	Facepiece	3M	Visions C5 RDI	p/n FP1xK0002xx0000
2	Batteries	3M	201506-01	3.6 VDC Li-Ion Batteries
3	Laptop PC	HP	EliteBook	Support Equipment

#### 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	Near-field communication (NFC) for RFID tag reading from the filter
2	Voice and functional data transfer via Bluetooth radio using 3M Messaging Protocol.

#### 3.6 Exercising of EUT and Interfaces

No.	Mode of Operation
1	Continues transmission of modulated signal at 13.56MHz
2	Bluetooth was placed into a normal "paired" mode with Laptop Computer as per the normal intended use for data logger updates via TerraTerm program.



## 4.0 Test Conditions and Results

<b>4.1</b>	<b>Conducted Emissions Data</b>			
<b>Method:</b>	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.			
<b>Test Verification:</b> <input type="checkbox"/>	Laboratory Ambient Temperature:			
	Relative Humidity:			
	Atmospheric Pressure:			
<b>Reference Standard(s):</b>	<input type="checkbox"/> FCC 15.207/RSS Gen <input type="checkbox"/> ANSI C63.4:2014 <input type="checkbox"/> ANSI C63.10:2013		<b>Measurement Point</b> <input type="checkbox"/> Mains <input type="checkbox"/> Telecommunication ports <input type="checkbox"/>	
	<b>Nominal Voltage:</b> <input type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input type="checkbox"/>			
<b>Test Personnel:</b>		<b>Date:</b>		
<b>Limits - Class A – AC Mains</b>				
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
<b>Limits - Class B – AC Mains</b>				
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

<b>Modifications:</b>	
<b>Note:</b>	

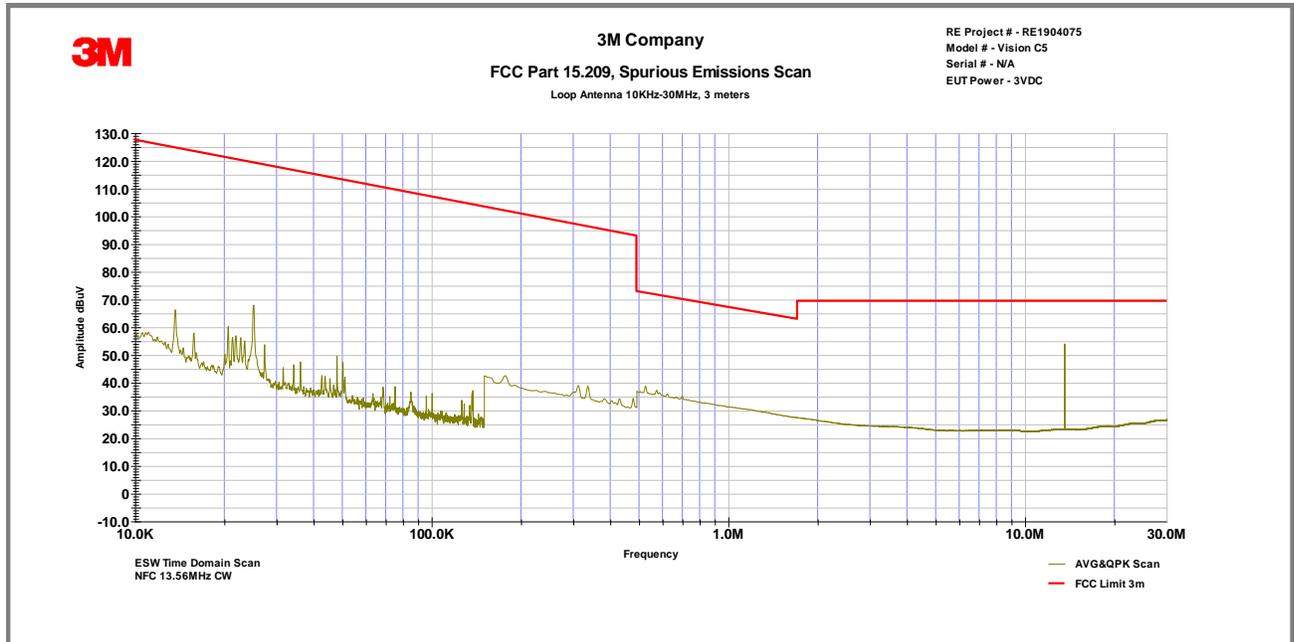


4.2 Radiated Emissions Data				
<b>Method:</b>	Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16 above 30MHz or either outside or in the chamber below 30MHz. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (quasi-peak) 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. Magnetic field measurements were made in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna, positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop was 1 m above the ground.			
<b>Test Verification:</b> <input checked="" type="checkbox"/>	Laboratory Ambient Temperature: 21°C			
	Relative Humidity: 28%			
	Atmospheric Pressure: 1006 mbars			
<b>Reference Standard(s):</b>	<input type="checkbox"/> ANSI C63.4:2014 <input checked="" type="checkbox"/> ANSI C63.10:2013 <input type="checkbox"/>			
	<b>Measurement Distance</b> <input checked="" type="checkbox"/> 3 Meters <input type="checkbox"/>			
<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 9KHz to 30MHz <input checked="" type="checkbox"/> 30MHz to 1000MHz			
<b>Nominal Voltage:</b>	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 3.6VDC			
<b>Test Personnel:</b>	Yuriy Litvinov <b>Date:</b> 04/16/2020			
<b>Limits – 15.209 and RSS-Gen</b>				
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Average	Distance	Result
0.009-0.490		2400/F(KHz)	300	pass
0.490-1.705	24000/F(KHz)		30	pass
1.705-30	30		30	pass
30 to 88	40		3	pass
88 to 216	43.5		3	pass
216 to 960	46		3	pass
Above 960		54	3	N/A

<b>Modifications:</b>	
<b>Note:</b>	<p>For emission in the restricted bands, the limit of 15.209 was used.</p> <p>The level of unwanted emissions from an intentional radiator above 30MHz has not exceed 15.209 limit. All radiated emissions above 30MHz listed in the table is associated with unintentional radiation form the device.</p> <p>The lower limit applies at the transition frequency. An inverse proportionality factor of 40dB per decade has been used below 30MHz and 20dB above 30MHz to normalize the measured data to the specified distance for determining compliance.</p>



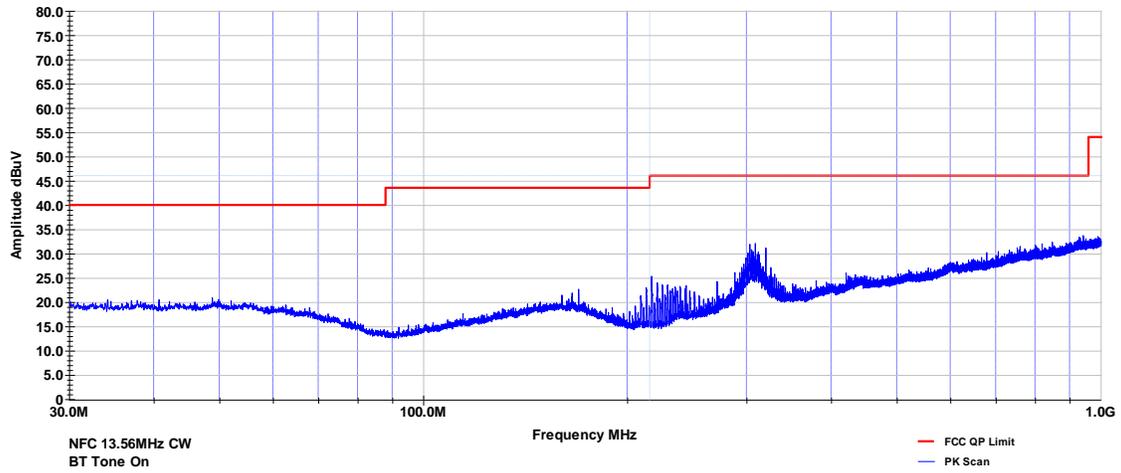
Frequency (MHz)	Pol.	QP Reading dBµV/m	Total CF dB	Net at 3 m dBµV/m	Limit (dBµV/m)	Margin dB
0.05	V		70.69	47.61	113.26	-65.65
0.0847	V		65.97	36.87	108.59	-71.73
0.1371	V		62.03	37.34	104.31	-66.97
0.177	V		59.81	42.73	102.04	-59.32
0.5238	V		50.8	38.96	72.47	-33.51
55.41	H	3.3	18.2	21.5	40	-18.5
159.44	V	3.3	18.3	21.6	43.5	-21.9
217.25	H	7.5	14.6	22.1	46	-23.9
229.21	V	6.5	15.2	21.7	46	-24.3
309.26	H	6.5	18.9	25.3	46	-20.7
319.09	H	3.6	19.2	22.8	46	-23.2
<b>Notes:</b>	Net Reading (dBuV) = Reading (dBµV)+Total CF(dB) Measurements <30MHz includes Loop Antenna correction factor Field strength of emissions measurements outside 13.110-14.010MHz band of operation.					





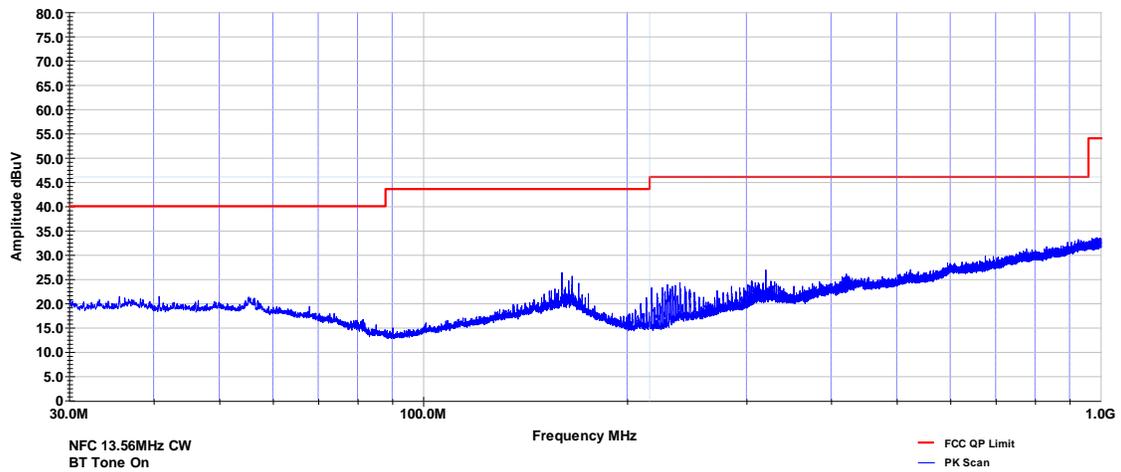
3M Company  
Radiated Emissions  
FCC Part 15, Class B, Horizontal

Project # - RE1904075  
Model # - Vision C5  
Serial # - N/A  
EUT Power - 3VDC



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

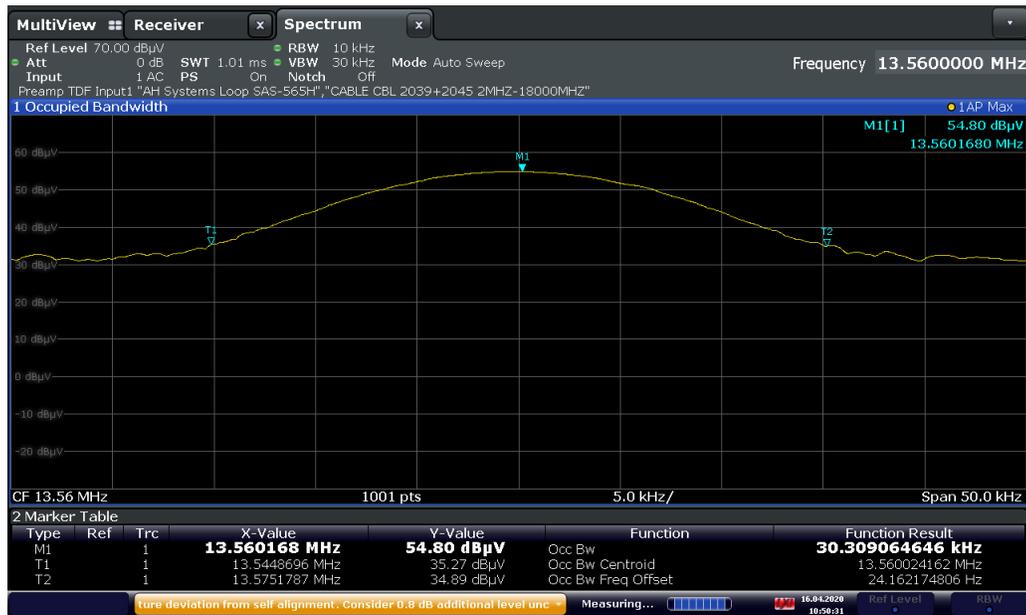
Project # - RE1904075  
Model # - Vision C5  
Serial # - N/A  
EUT Power - 3VDC





<b>4.3 Occupied bandwidth</b>	
	Laboratory Ambient Temperature: 23°C
	Relative Humidity: 28%
	Atmospheric Pressure: 1006 mbars
<b>Reference Standard(s):</b>	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> RSS-Gen <b>Measurement Point</b> <input type="checkbox"/> Conducted <input checked="" type="checkbox"/> Radiated
<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 13.553 MHz -13.567 MHz RBW = 10KHz VBW ≥ 3 x RBW
<b>Nominal Voltage:</b>	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 3.6VDC
<b>Test Personnel:</b>	Yuriy Litvinov <b>Date:</b> 04/14/2019

Frequency (MHz) (PR-ASK)	20 dB Bandwidth (KHz)	99% Bandwidth (KHz)	Results
13.553 -13.567	30	30	pass

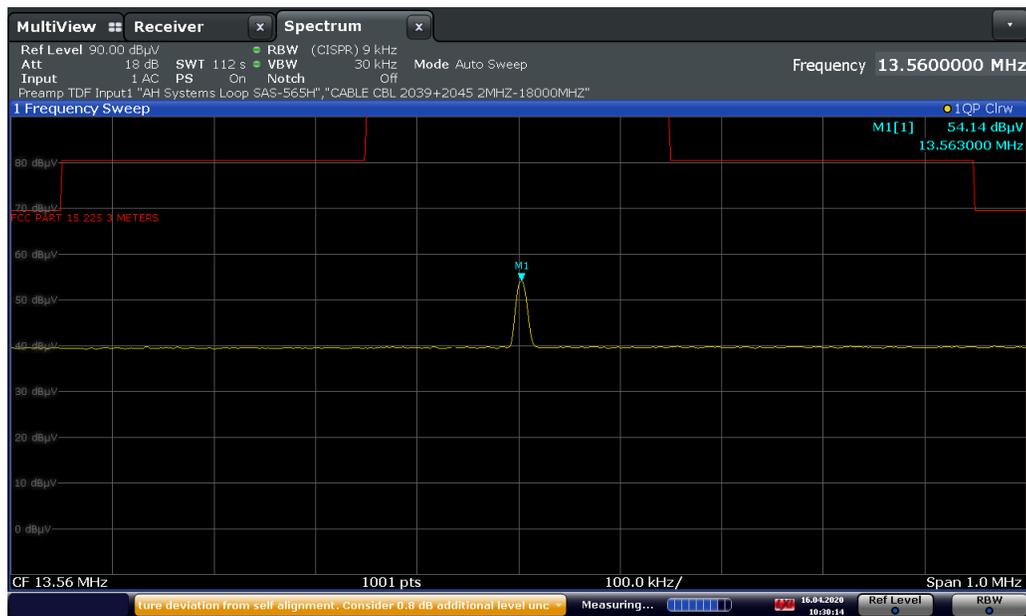




4.4	In-Band Radiated Spurious Emissions		
<b>Method:</b>	Measurements was performed with modulated carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	18%	
	Atmospheric Pressure:	1006 mbars	
<b>Reference Standard(s):</b>	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input type="checkbox"/>	<b>Measurement Point</b> <input type="checkbox"/> Conducted <input checked="" type="checkbox"/> Radiated at 3 meters	
<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 13.553 MHz -13.567 MHz		
	<b>Frequency (MHz)</b>	<b>Field Strength uV/m at 30m</b>	<b>Field Strength dBuV/m at 3m</b>
<b>Limit</b>	1.705-13.110	30	69.5
	13.110-13.410	106	80.5
	13.410-13.553	334	90.5
	13.553-13.567	15848	124.0
	13.567-13.710	334	90.5
	13.710-14.010	106	80.5
	14.010-30.0	30	69.5
<b>Nominal Voltage:</b>	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 3.6VDC		
<b>Test Personnel:</b>	Yuriy Litvinov		<b>Date:</b> 04/14/2019



Frequency (MHz)	Pol	Net QP Reading dBµV/m	Limit (3m) (dBµV/m)	Margin dB	Antenna Height (m)
13.56	V	54.15	124	69.85	1.0
13.57	V	31.3	90.5	59.2	1.0
13.64	V	31.8	80.5	48.7	1.0
13.72	V	31.3	80.5	48.2	1.0
14.02	V	31.3	69.5	38.2	1.0
13.53	V	31.8	80.5	48.7	1.0
13.49	V	31.3	80.5	48.7	1.0
13.1	V	31.3	69.5	38.2	1.0
<b>Notes:</b> Measurements <30MHz includes Loop Antenna correction factor					





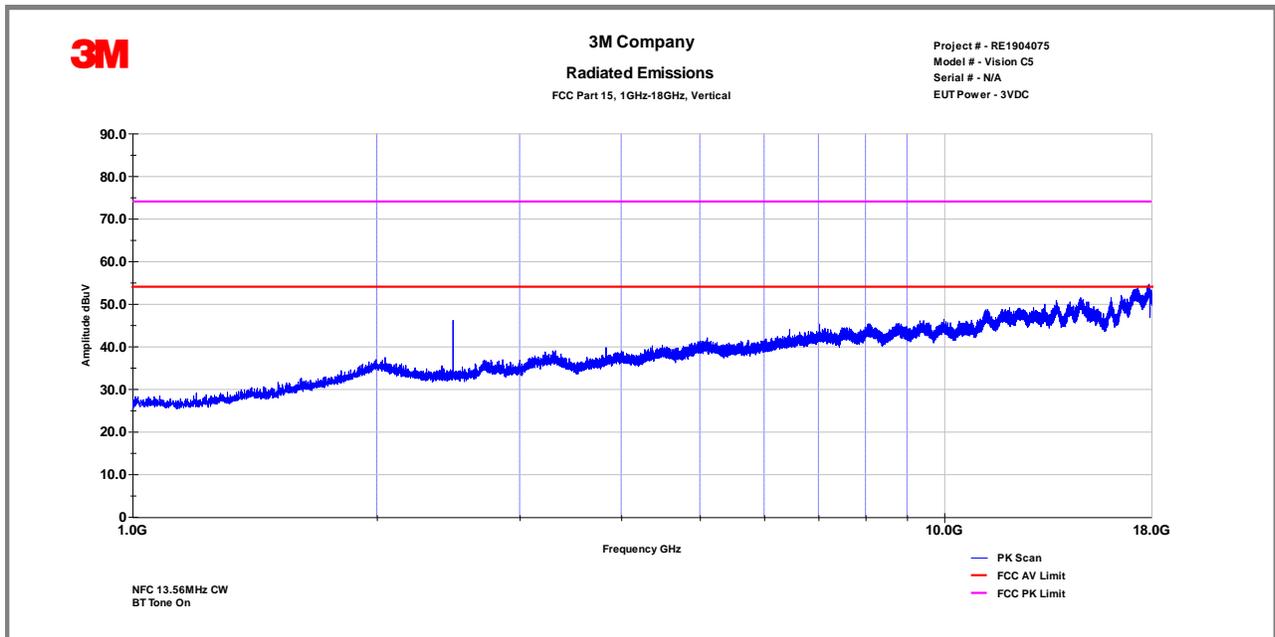
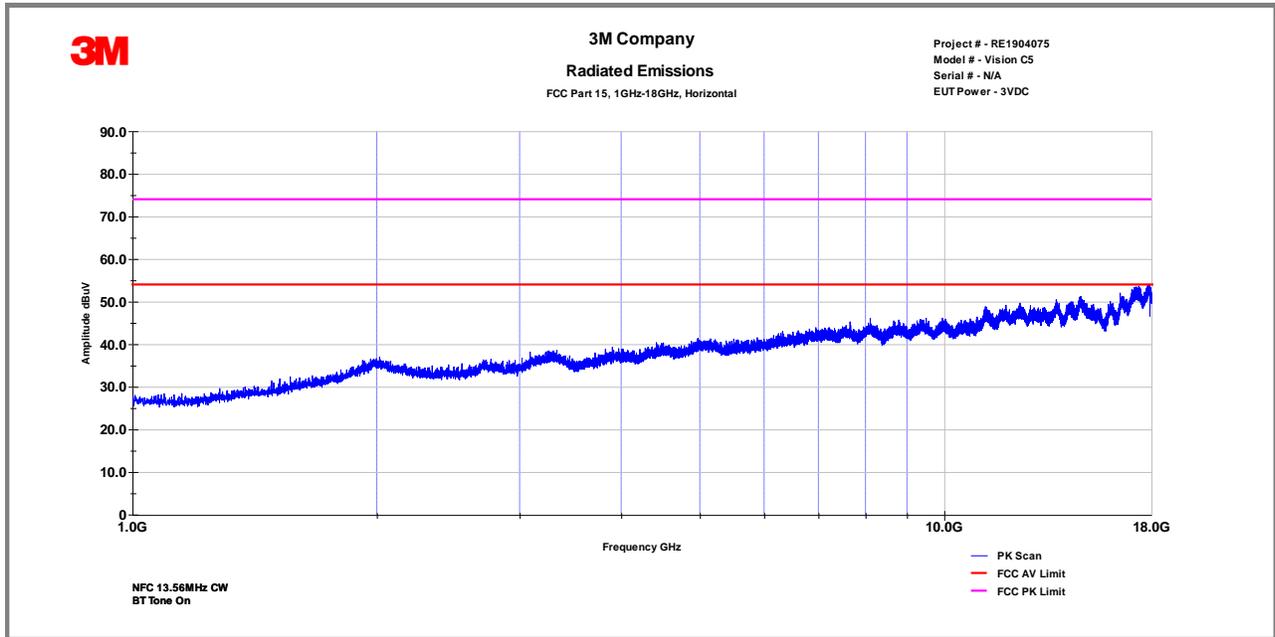
<b>4.5</b>	<b>Frequency Stability</b>		
<b>Method:</b>	Measurements was performed with modulated carrier at the highest power level at which the transmitter is intended to operate. The frequency was measured under normal and extreme test conditions test conditions. The analyzer offset was adjusted to compensate for the attenuator and other losses. During extreme test conditions, both extreme temperature and voltage apply simultaneously.		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	18%	
	Atmospheric Pressure:	1006 mbars	
<b>Reference Standard(s):</b>	<input checked="" type="checkbox"/> Part 15.225/RSS-210 <input checked="" type="checkbox"/> ANSI C63.10:2013	<b>Measurement Point</b> <input type="checkbox"/> Conducted <input checked="" type="checkbox"/> Radiated	
<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 13.553 MHz -13.567MHz	<b>Maximum Deviation</b>	
<b>Limit:</b>	<input checked="" type="checkbox"/> ± 100ppm (± 0.01%)	60 ppm	
<b>Nominal Voltage:</b>	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 3.6VDC		
<b>Extreme Temperature Ranges:</b>	<input checked="" type="checkbox"/> General	<input checked="" type="checkbox"/> - 20.0 to +55.0C <sup>0</sup>	
	<input type="checkbox"/> Portable	<input type="checkbox"/>	
	<input type="checkbox"/> Indoor Use	<input type="checkbox"/>	
<b>Extreme Test Voltages:</b>	<input type="checkbox"/> Mains Voltage	<input type="checkbox"/> ± 15%	
	<input checked="" type="checkbox"/> Battery	<input type="checkbox"/> 0.85 <input type="checkbox"/> 1.15	Test performed with a fully charged battery
<b>Test Personnel:</b>	Yury Litvinov		<b>Date:</b> 04/15/2019

Channel Frequency (MHz)	Temperature C <sup>0</sup>	Voltage (VDC)	Measured Frequency (MHz)	Frequency Deviation (ppm)	Result
13.56MHz	55	Battery	13.5600	60	pass
	40	Battery	13.5595	0	pass
	30	Battery	13.5597	0	pass
	20	Battery	13.5591	0	pass
	10	Battery	13.5595	0	pass
	0	Battery	13.5595	0	pass
	-10	Battery	13.5595	0	pass
	-20	Battery	13.55921	56	pass



4.6		Radiated Emissions in restricted band		
<b>Method:</b>	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.			
<b>Test Verification:</b> <input checked="" type="checkbox"/>	Laboratory Ambient Temperature:	23°C		
	Relative Humidity:	18%		
	Atmospheric Pressure:	1006 mbars		
<b>Reference Standard(s):</b>	<input type="checkbox"/> ANSI C63.4:2014	<b>Measurement Distance</b>		
	<input checked="" type="checkbox"/> ANSI C63.10 2013 <input checked="" type="checkbox"/> KDB 996369 D04 <input type="checkbox"/>			
<b>Frequency Range:</b>	<input type="checkbox"/> 30 MHz to 1 GHz <input checked="" type="checkbox"/> 1 GHz to 26 GHz			
<b>Nominal Voltage:</b>	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 3.6VDC			
<b>Test Personnel:</b>	Yuriy Litvinov		<b>Date:</b> 04/15/2019	
<b>Limits – 15.209 and RSS-Gen</b>				
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Average	Distance	Result
0.009-0.490		2400/F(KHz)	300	N/A
0.490-1.705	24000/F(KHz)		30	N/A
1.705-30	30		30	N/A
30 to 88	40		3	N/A
88 to 216	43.5		3	N/A
216 to 960	46		3	pass

<b>Modifications:</b>	
<b>Note:</b>	<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>BT in "paired" mode for RF module verifications</p> <p>No radiated spurious emissions were detected above 18GHz.</p>





4.7 RF Exposure Evaluation	
Reference Standard(s):	<input checked="" type="checkbox"/> KDB 447498 <input checked="" type="checkbox"/> RSS 102, Issue 5 <input checked="" type="checkbox"/> <input type="checkbox"/> MPE <input type="checkbox"/> SAR Evaluation <input checked="" type="checkbox"/> SAR Test Exclusion
Frequency Range:	<input checked="" type="checkbox"/> 2402-2480.0MHz <input checked="" type="checkbox"/> 13.56MHz
Antenna Separation Distance: >35mm	
Antenna Gain (maximum): 0dBi (PCB Ceramic)	
BLE Maximum Output Power at antenna terminal: 5.14mW (7dBm)	
RFID Maximum Power: M24LR RF Operating Current 0.0002A (50 Ohm load) The power calculation is $P = 0.0002A^2 \times 50 \text{ Ohm} = 0.2mW$	
RF Exposure Conditions: Face worn	
Power Density: N/A	
<b>SAR Test Exclusion Threshold</b>	
FCC Part 2.1093	67mW@ >35mm @2.45GHz
RSS 102, Issue 5, 2015	123mW@ >35mm @2.45GHz
FCC Part 2.1093	308mW@ < 50mm @10-50MHz
RSS 102, Issue 5, 2015	71mW@ <5mm @<300MHz
Note:	



5.0

## Test Equipment

## Test Equipment Used

Description	Manufacturer	Model	Identifier	Last Cal. Date	Check
Biconilog Antenna	Schwarzbeck	VULB 9168	9168-1070	10/20/2019	<input checked="" type="checkbox"/>
Horn Antenna	A.H. Systems	SAS 571	1010	10/20/2019	<input checked="" type="checkbox"/>
Loop Antenna	A.H. Systems	SAS-565H	1213E	10/20/2019	<input checked="" type="checkbox"/>
Signal Analyzer	Agilent	N9000A	MY53031040	10/20/2019	<input checked="" type="checkbox"/>
EMI Receiver	Rohde & Schwarz	ESW26	101412	10/20/2019	<input checked="" type="checkbox"/>
LISN	TESEQ	NNB51	1130	10/20/2019	<input type="checkbox"/>
EMC Software	ETS-Lindgren	TILE 7		N/A	<input checked="" type="checkbox"/>
<b>Equipment Calibration Interval:</b>		<input checked="" type="checkbox"/> 12 months		<input type="checkbox"/> 24 months	

6.0

## Report revision history

Revision Level	Date	Report Number	Notes
0	04/24/2020	RE1904075-1	Original Issue