EMC TEST REPORT



Standard(s):

47 CFR FCC Part 15.225, FCC Parts 15.247(d)/15.209, RSS 210, Issue 9, 2016, ICES 003, Issue 6, 2016

FCC ID:DGFPSDTR602CX IC:458A-PSDTR602CX

Product: 3M™ Versaflo™ Powered Air Respirator Model(s): TR600CX

Company Name: 3M Company

Address:

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

Report Number: RE1705035-4 Report Issue Date: June 7, 2019

Report Prepared by:

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

	Device is battery operated. Device contains Laird Technologies 2.4 GHz Bluetooth Low Energy Module, FCC ID: TFB-1005 and IC:5969A-1005.
Note:	FCC Test Report number FR742502 issued by International Certification Corp. on April 25, 2017 for the Laird, Model: SaBLE-x-R2 which is filed in this authorization remains applicable and valid of performance within this device: Radiated Spurious Emissions, Output Power, 6dB Bandwidth, Band-edge Compliance and Power Spectral Density

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



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2.0 Equipment Description

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2.1	2.1 Equipment Under Test					
	Description:	Powered Air Purifying Respirator for use in rugged environments such as industrial, demolition, grinding, metal finishing and casting operations.				
	Model(s):	TR600CX				
	Serial number:	3M TPB-999				
	Contact:	Keith Lyksett				
	Phone:	+16517362009				
	3M Division:	Personal Safety				
Mod	ifications and Special Measures:	N/A				
	Frequency Range:	13.56MHz NFC		2402-2480MHz BL	E	
	Channel No.:	1				
	Modulation Type: ASK					
	Maximum Output Power:	r: N/A				
	Antenna Type:	e: Internal PCB Loop Antenna				
EU	Γ Highest Internal Frequency (F _x):	<10MHz				
	Test Deviations or Exclusions	Yes	⊠ No			
		Voltage:	☐ 120VAC	☐ 230VAC		
	Rated Power:	Phase:	☐ 1ph	☐ 3ph	□ Battery	
	Rated Power:	Frequency:	☐ 50Hz	☐ 60Hz		
		Current:				
	Test Dates:	02/18-02/22/2019				
	Received Date:	e : 02/13/2019				
	Received Conditions:	☐ Poor ☐ Good				
Received Conditions:		□ Prototype	Prototype			



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3.0 EUT Configuration

3.1 System Configuration

No.	Product Type	Manufacturer	Model	Comments
1	Blower Assembly	3M	TR-600CX	
2	Li-lon battery	3M	TR-632	Support Equipment
3	Battery Charger	3M	TR-640	Support Equipment

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	Near-field communication (NFC) for RFID tag reading from the filter				
2	Transferring of various environmental and functional data via Bluetooth radio using 3M Active Safety Messaging Protocol.				

3.6 Exercising of EUT and Interfaces

No.	Mode of Operation			
1	Continues transmission of modulated signal at 13.56MHz			
2	BLE transmitting at low channels of operation with CW carrier			



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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				
		Voltage Probe.	vinore an 70 av wae not appro	opriate or availab	on modernmente were made doing a
			Laboratory Ambient	Temperature:	
	Test Verifi	cation:	Rela	tive Humidity:	
			Atmosphe	eric Pressure:	
Reference Standard(s):			☐ FCC 15.207/RSS Gen ☐ 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	ins	
Fraguesa	ov (NALL a)		Limit d	B (μV)	
Frequenc	y (IVI⊓∠)	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	N/A	AMN
0.50	to 5	56	46	N/A	AMN
5 to	30	60	50	N/A	AMN

Modifications:	
Note:	



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4.2	Radiated Emissions Dat	a						
Method:	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.							
	Laboratory Ambient Temperature: 21°C							
Tes	t Verification:		Relative Hum	nidity:		18%		
			Atmospheric Pres	sure:		836.8 mb	ars	
		☐ ANSI C63.4:20			Measurement Distance			
	Reference Standard(s):					⊠ 3 Meters □		
	Frequency Range:		☑ 9KHz to 30MHz☑ 30MHz to 1000KHz					
	Nominal Voltage:	☐ 120VAC 🖾 1	I1.1VDC					
	Test Personnel:	Keith Schwartz /	2.	D	Date: 02/18/2019			
		Limits - 15.	209 and RSS Gen					
	0.009-0.490		2400/F(KHz)	30	00	300	pass	
	0.490-1.705	24000/F(KHz)		3	0	30	pass	
	1.705-30	30		3	0	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	

Modifications:	
Note:	For emission in the restricted bands, the limit of 15.209 was used. 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.
	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.



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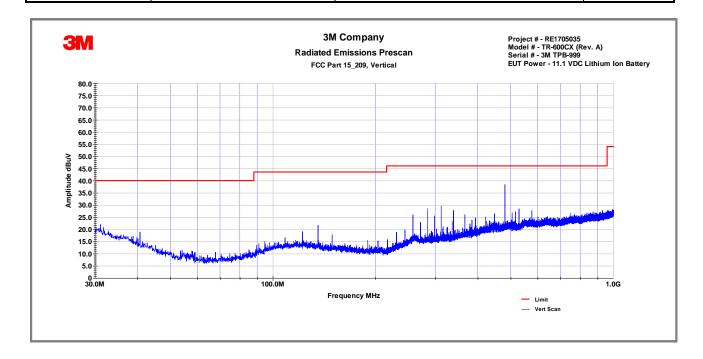
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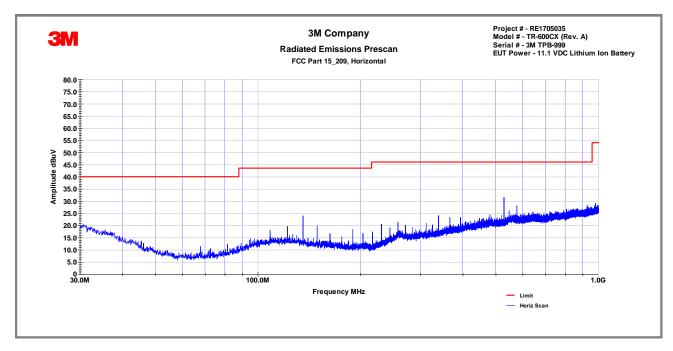
Frequency (MHz)	Pol.	QP Reading dBµV/m	Total CF dB	Net at 3 m dBµV/m	Limit (dBµV/m)	Margin dB	
10.38*		-13.6	40.50	26.9	70	-43.1	
27.62*		8.5	32.70	24.2	70	-45.8	
135.54	Н	9.7	16.3	26	43.5	-17.6	
284.74	V	9.9	18.2	28.2	46	-17.8	
311.88	V	10.8	18.9	29.7	46	-16.3	
338.5	V	12.2	19.3	31.5	46	-14.5	
480.33	Н	6.5	23.2	29.7	46	-16.3	
528.18	Н	5.9	23.4	29.3	46	-16.7	
Notes:	Notes: 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. It is found to be attenuated below Part 15.209 limits (70dBuV/m at 3mters).						

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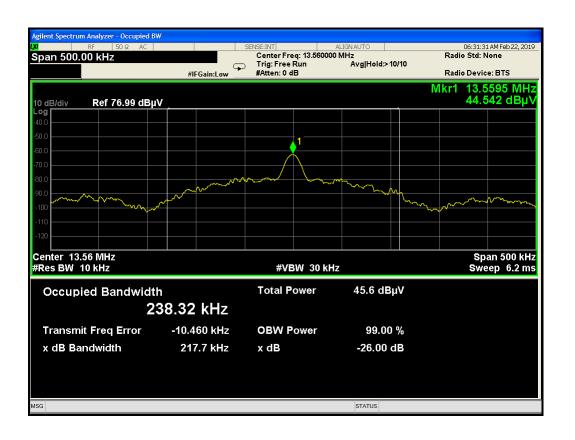




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4.3 Occupied ba	4.3 Occupied bandwidth							
	Laboratory Ambient Temperature:	23°C						
	Relative Humidity:	18%						
	Atmospheric Pressure:	836.8 mbars						
Reference Standard(s):	Measurement Point ☐ Conducted ☐ Radiated						
Frequency Rang	ye:	RBW = 10KHz VBW ≥ 3 x RBW						
Nominal Voltage	le: ☐ 120VAC ☐ 11.1VDC							
Test Personn	el: Yuriy Litvinov ywy dunhov	Date: 02/22/2019						

Frequency (MHz)	26 dB Bandwidth	99% Bandwidth	Results
(PR-ASK)	(KHz)	(KHz)	
13.553 -13.567	217.7	238.3	pass





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4.4	In-Band Radiated	d Spurious Emissions	Spurious Emissions					
Method:			performed with modulated carrier at the highest power level at which the transmitter is The analyzer offset was adjusted to compensate for the attenuator and other losses.					
		Labora	23°C					
			Relative Humidity:	18%				
			Atmospheric Pressure:	836.8 mbars				
Refere	ence Standard(s):	 ✓ ANSI C63.10:2013 ✓ FCC Part 15.255/RSS210 ✓ FCC Part 15.109/ICES 003 ✓ FCC Part 15.209 	Measurement Point ☐ Conducted ☐ Radiated at 3 meters					
F	requency Range:	☑ 13.553 MHz -13.567 MHz	☑ 13.553 MHz -13.567 MHz					
		Frequency (MHz)	Field Strength uV/m at 30m	Field Strength dBuV/m at 3m				
		1.705-13.110	30	69.5				
		13.110-13.410	106	80.5				
		13.410-13.553	334	90.5				
	Limit	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				
	Nominal Voltage:	☐ 120VAC 🗵 11.1VDC						
	Test Personnel:	Keith Schwartz KS		Date: 02/18/2019				

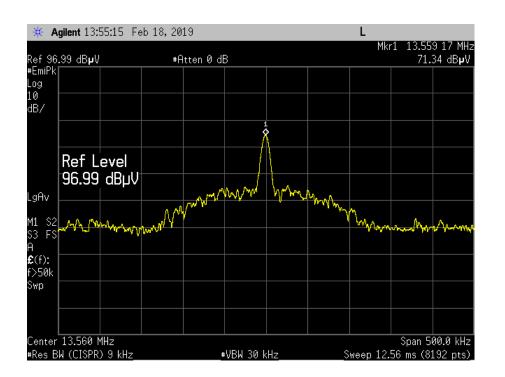


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Frequency (MHz)	Pol (XYZ)	Net QP Reading dBµV/m	Limit (3m) (dBµV/m)	Margin dB	Antenna Height (m)
13.56	Υ	71.3	124	-52.7	1.0
13.57	Υ	60.3	90.5	-30.2	1.0
13.64	Υ	50.5	80.5	-30	1.0
13.72	Υ	39.2	80.5	-41.3	1.0
14.02	Υ	38.3	69.5	-31.2	1.0
13.53	Υ	54	80.5	-26.5	1.0
13.49	Υ	49.4	80.5	-31.1	1.0
13.1	Υ	37.5	69.5	-32	1.0
Notes:	Measurement	ts <30MHz includes Loop	Antenna correction fac	tor	





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4.5	Frequency Stability	Frequency Stability					
Method:	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:	836.8 mbars			
Reference Standard(s):		☑ Part 15.225/RSS-210☑ ANSI C63.10:2013		Measurement Point ☐ Conducted ☐ Radiated			
	Frequency Range:	☑ 13.553 MHz -13	3.567MHz	Maximum Deviation			
	Limit:		.01%)	60 ppm			
	Nominal Voltage:	☐ 120VAC 🖂 1	1.1VDC				
		□ General	⊠ - 20.0 to +55.0C ⁰				
Extreme	Temperature Ranges:	☐ Portable					
		☐ Indoor Use					
			<u>+</u> 15%				
Extreme Test Voltages:		Battery ■ ■ Battery ■	□ 0.85 □ 1.15	Test performed with a fully charged battery			
	Test Personnel:	Keith Schwartz K	2	Date: 02/22/2019			

Channel Frequency (MHz)	Temperature C ⁰	Voltage (VDC)	Measured Frequency (MHz)	Frequency Deviation (ppm)	Result
	55	Battery	13.55918	60	pass
	40	Battery	13.5593	0	pass
	30	Battery	13.5593	0	pass
40 CCM I-	20	Battery	13.5593	0	pass
13.56MHz	10	Battery	13.5593	0	pass
	0	Battery	13.5593	0	pass
	-10	Battery	13.5593	0	pass
	-20	Battery	13.55923	56	pass

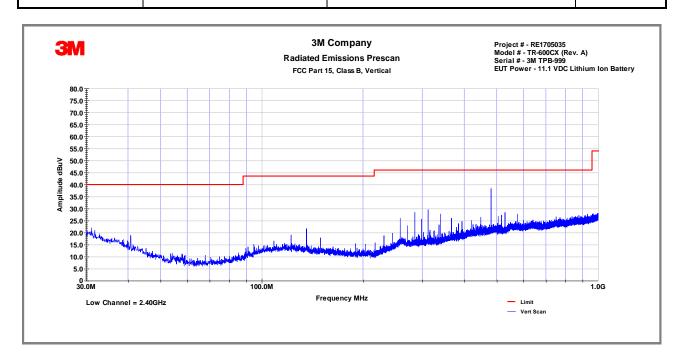


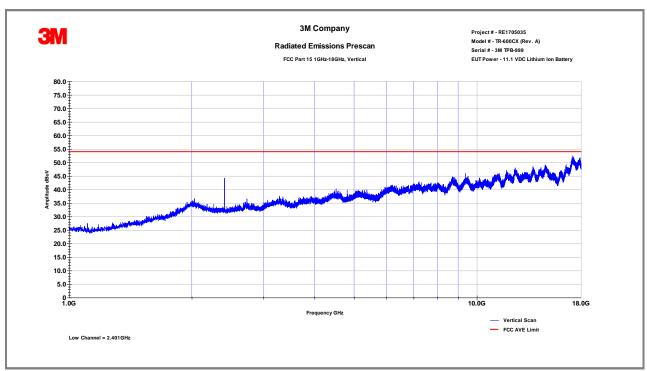
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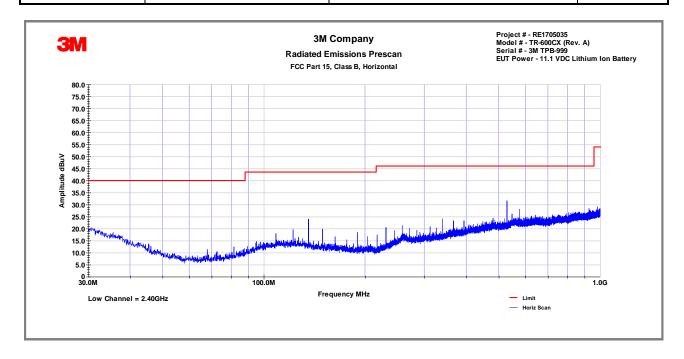


4.4	Radiated Emissions in r	estricted band					
Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4. EUT was rotated through three orthogonal axes to determine which attitude (orientation) and arrangement produces the highest emission relative to the limit; 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.							
	Laboratory Ambient Temperature: 23°C						
Tes	t Verification:		Relative Hum	nidity:		18%	
			Atmospheric Pres	sure:		836.8 mba	ars
		☐ ANSI C63.4:20			Measurement Distance		
	Reference Standard(s):	☑ ANSI C63.10:2☑ KDB 996369 □			☑ 3 Meters ☐		
	Frequency Range: Sign 30 MHz to 1 GHz Sign 1 GHz to 26 GHz						
	Nominal Voltage:	☐ 120VAC 🖾 1	1.1VDC				
	Test Personnel:	Keith Schwartz K	2.	Date	Date: 02/18/2019		
		Limits – 15.2	209 and RSS-Gen				
	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

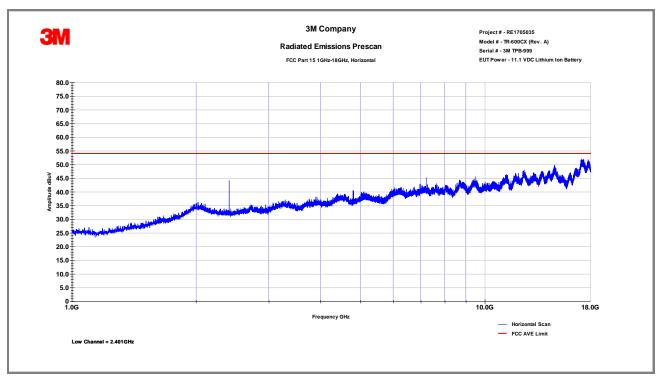
Modifications:	
Note:	For emission in the restricted bands, the limit of 15.209 was used. The lower limit applies at the transition frequency. An inverse proportionality factor of 20 dB per decade has been used to normalize the measured data to the specified distance for determining compliance
	Low BLE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







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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	PK Margin dBµV/m	AVG Margin dB
V	4804.00	47.80	40.9	-6.29	41.51	34.61	74.00	54.00	-32.49	-19.39
Н	4804.00	46.60	39.6	-6.29	40.31	33.31	74.00	54.00	-33.69	-20.69
V	7206.00	46.80	35.2	-3.01	43.79	32.22	74.00	54.00	-30.21	-21.78
Н	7206.00	46.31	35.4	-3.01	43.30	32.39	74.00	54.00	-30.70	-21.61
	Net Reading (dBuV) = Reading (dB _µ V) + (Antenna with amp CF(dB)+Cable CF(dB))									
	Notes:	Low Channel								



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4.7 RF Exposure Evaluati	RF Exposure Evaluation					
Reference Standard(s):						
Frequency Range:						
Antenna Separation Distance:	>10mm					
Antenna Gain (maximum):	0dBi (PCB trace)					
BLE Maximum Output Power at antenna terminal:						
RFID Maximum Power:	M24LR RF Operating Current 0.0002A (50 Ohm load) The power calculation is P = 0.0002A ² x 50 Ohm = 0.2mW					
RF Exposure Conditions:	Belt-worn					
Power Density:	N/A					
	SAR Test Exclusion Threshold					
FCC Part 2.1093	19mW@ >10mm @2.45GHz					
RSS 102, Issue 5, 2015 7mW @ >10mm @2.45GHz						
FCC Part 2.1093 308mW @ < 50mm @10-50MHz						
RSS 102, Issue 5, 2015	RSS 102, Issue 5, 2015 71mW @ <5mm @ <300MHz					

Note:	
Note.	



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5.0	Test Equipment						
Test Equipment Used							
Description Manufacturer Model Identifier Last Cal. Date Ch					Check		
Biconilog Ante	enna	Schaffner	CBL6112B	27491	10/20/2018	\boxtimes	
Horn Antenna		A.H. Systems	SAS 571	1010	10/20/2018	\boxtimes	
Loop Antenna		A.H. Systems	EHA-51B	1213E	10/20/2018		
Loop Antenna		EMCO	ALR25M	1011	10/20/2018	\boxtimes	
Signal Analyzo	ər	Agilent	N9000A	MY53031040	10/20/2018	\boxtimes	
EMI Receiver		Agilent	E4448A	1530975	10/20/2018	\boxtimes	
LISN		TESEQ	NNB51	1130	10/20/2018		
EMC Software ETS-Lindgren		TILE 7		N/A	\boxtimes		
Equipment Calibration Interval:				12 months	24 months		

6.0	Report revision history						
Revision L	evel	Date	Report Number	Notes			
0		06/07/2019	RE1705035-4	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: Versaflo™ Powered Air Respirator

MODEL NUMBER(S): TR600CX
TEST REPORT NUMBER: RE 1705035-4
DATE OF ISSUE: June 7, 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

FCC Part 15.225

License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

RSS 210, issue 9, 2016

FCC Part 15B

ICES-003, Issue 6, 2016

Comments:

NVLAP Lab Code 200033-0

Yuriy Litvinov Lead EMC Engineer

young divinor