

EMC TEST REPORT



Standard(s):

47 CFR FCC Parts 15.247 and 15.109
RSS 247, Issue 2, 2017
ICES 003, Issue 6, 2016

FCC ID: DGFPDTR602CX1
IC: 458A-PSDTR602CX1

Product: 3M™ Versaflo™ Powered Air Respirator

Model(s): TR-600-CX

Company Name:
3M Company

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

Report Number: RE1908179-1
Report Issue Date: March 17, 2020

Report Prepared by:

Signature: 
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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	15.209/15.109/ 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 the battery.

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:	Powered Air Purifying Respirator for use in rugged environments such as industrial, demolition, grinding, metal finishing and casting operations.			
Model(s):	TR-600-CX			
Serial number:	N/A			
Contact:	Peter Brudzinski			
Phone:	651 736 9053			
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:	-2.45dBm (0.6mW)			
Antenna Type:	Internal PCB Antenna			
Antenna Gain:	1.15 dBi			
Test Deviations or Exclusions	<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No	
Rated Power:	Voltage:	<input type="checkbox"/> 120VAC	<input type="checkbox"/> 230VAC	<input checked="" type="checkbox"/> 11.1VDC
	Phase:	<input type="checkbox"/> 1ph	<input type="checkbox"/> 3ph	<input checked="" type="checkbox"/> Battery
	Frequency:	<input type="checkbox"/> 50Hz	<input type="checkbox"/> 60Hz	
	Current:			
Test Dates:	11/21-12/05//2019			
Received Date:	11/21/2019			
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	Blower Assembly	3M	TR-600 (rev.C)	
2	Li-Ion battery	3M	TR-632	Support Equipment
3	Battery Charger	3M	TR-640	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	Transferring of various environmental and functional data via Bluetooth radio using 3M Active Safety Messaging Protocol.

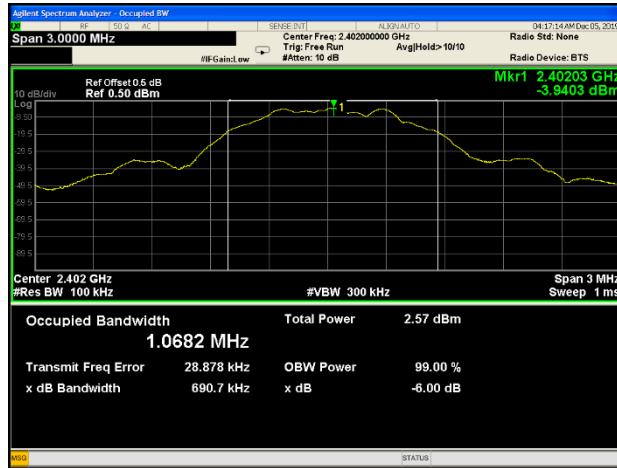
3.6 Exercising of EUT and Interfaces

No.	Mode of Operation
1	Transmitting at lowest (0), middle (19) and highest (39) channels of operation with unmodulated CW carrier
2	Continues transmission of modulated signal at 13.56MHz
3	Device programming using Nordic Studio BT software for continues transmission of modulated carrier at maximum rated RF output power and Duty Cycle.

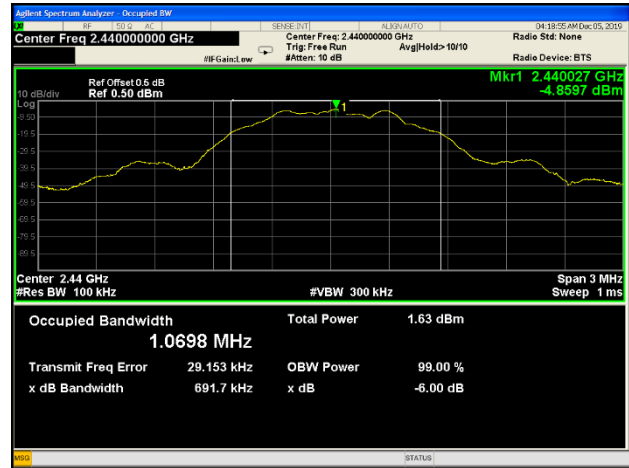
4.0 Test Conditions and Results

4.1	DTS Bandwidth		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247	Measurement Point <input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated	
Frequency Range:	<input checked="" type="checkbox"/> 2402.0-2480.0 MHz	RBW = 100KHz VBW ≥ 3 x RBW	
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 11VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>		Date: 12/05/2019

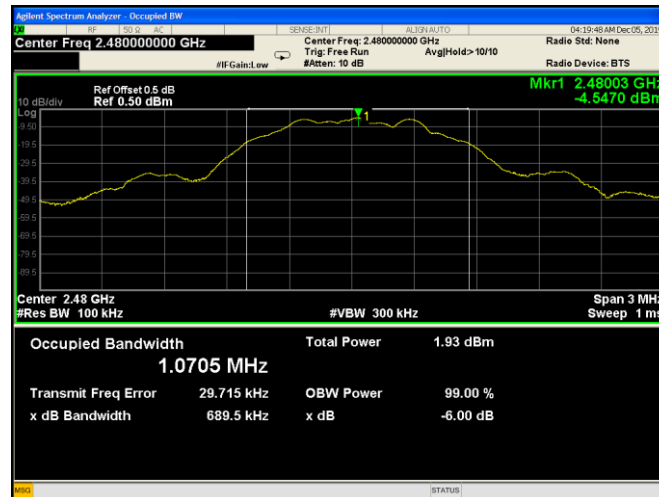
Frequency (MHz)	99% dB Bandwidth (KHz)	6 dB Bandwidth (KHz)	6dB OBW Limit (KHz)	Results
2402	1068	691	> 500	pass
2440	1069	692	> 500	pass
2480	1070	689	> 500	pass



OBW - Low Channel



OBW - Mid Channel



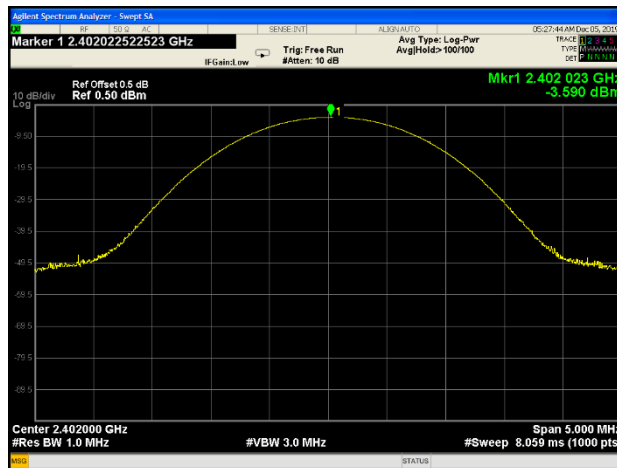
OBW - High Channel



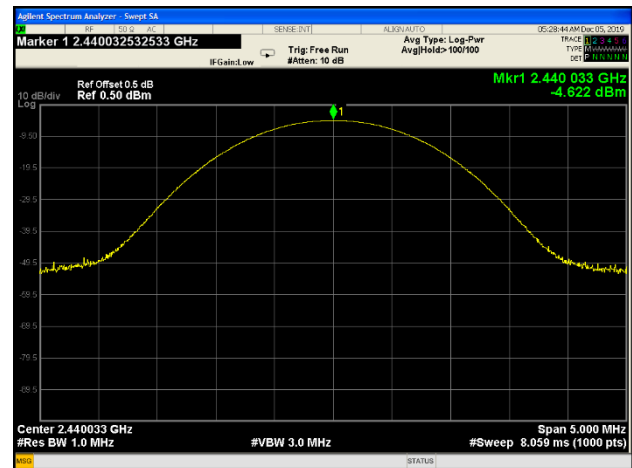
4.2	Maximum Output Power		
Method:	Measurements was performed with CW carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.		
		Laboratory Ambient Temperature:	23°C
		Relative Humidity:	48%
		Atmospheric Pressure:	1011 mbars
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input checked="" type="checkbox"/> KDB 558074	Measurement Point <input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated at 3 meters	
Frequency Range:	<input checked="" type="checkbox"/> 2402.0 – 2480.0 MHz		
Antenna Gain:	1.15 dBi	Maximum Conducted Power (EIRP):	
Limit:	30 dBm		
Nominal Voltage:		<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 12VDC	
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>		Date: 12/05/2019

Note:

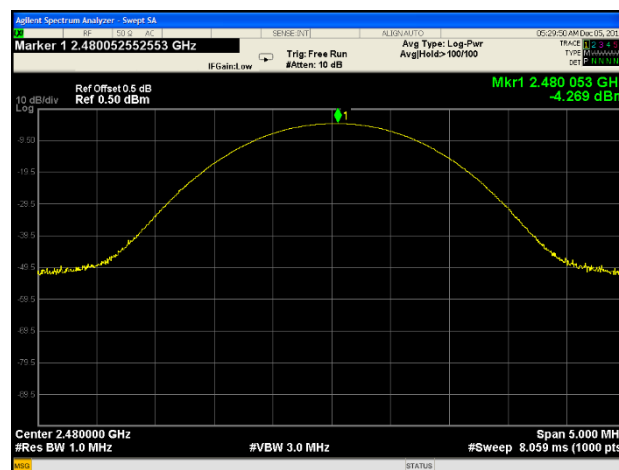
EIRP (dBm) = Conducted Power (dBm) +Antenna Gain (dBi)= -3.6+1.15= -2.45dBm



Low Channel



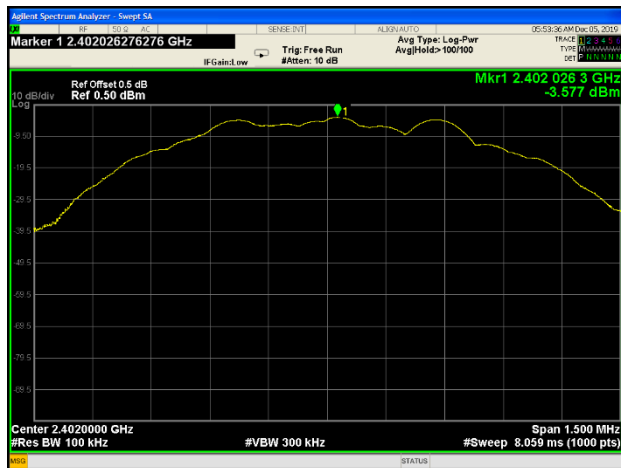
Mid Channel



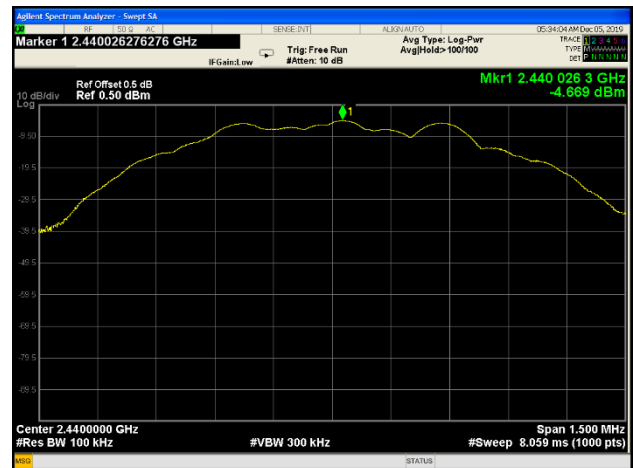
High Channel



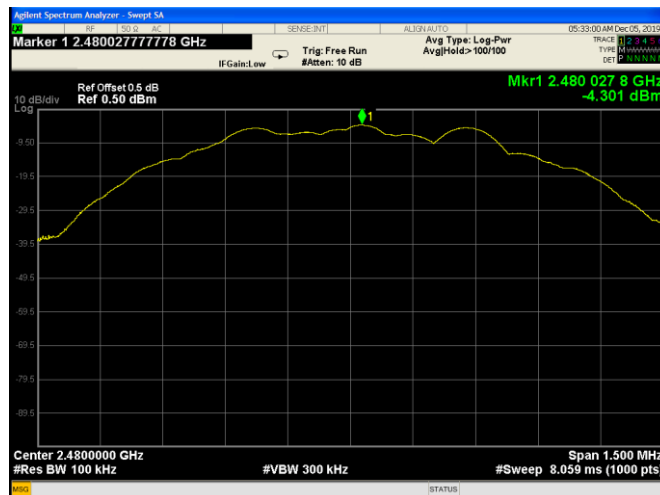
4.3	Maximum Power Spectral Density level		
Method:	Measurements was performed with modulated carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.		
		Laboratory Ambient Temperature:	23°C
		Relative Humidity:	48%
		Atmospheric Pressure:	1011 mbars
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input checked="" type="checkbox"/> KDB 558074 D01	Measurement Point <input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated at 3 meters	
Frequency Range:	<input checked="" type="checkbox"/> 2402.0 – 2480.0 MHz	PSD Results	
PSD Limit:	8 dBm	-3.6 dBm	
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 11VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>		Date: 12/05/2019



PSD Low Channel



PSD Mid Channel



PSD High Channel

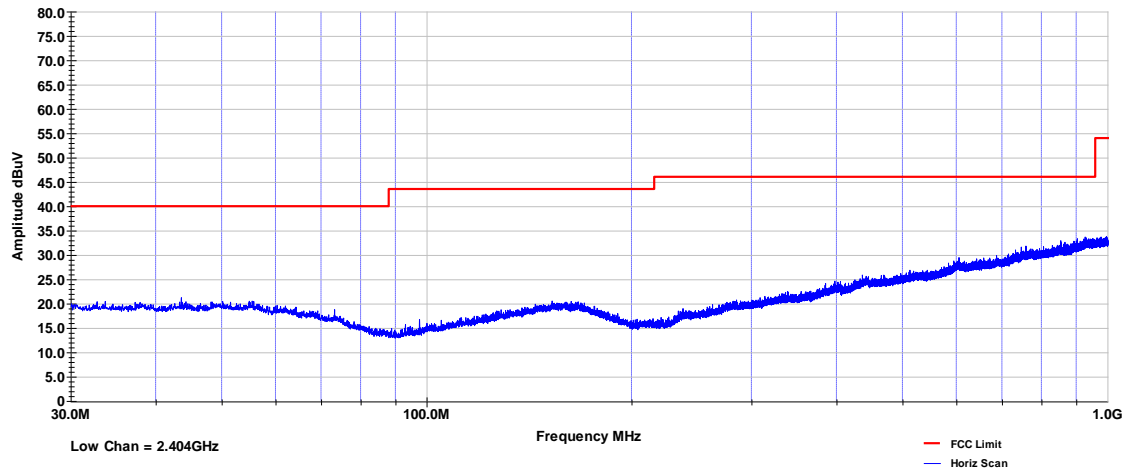
4.4	Radiated Emissions in restricted band				
Method:	Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4 standards. EUT was rotated through three orthogonal axes to determine which attitude (orientation) and arrangement produces the highest emission relative 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 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:		55%		
	Atmospheric Pressure:		1011 mbars		
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2013, Section 11.12.1 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input type="checkbox"/>		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 25 GHz				
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 11VDC				
Test Personnel:	Keith Schwartz <i>KS</i>			Date: 11/21/2019	
Limits –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:	<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>For emission in the restricted bands, the limit of 15.209 was used.</p> <p>There are no emissions were detected in the restricted band within 30dB below 15.209 limit adjacent or nearby to 2400-2483.5MHz frequency band during operation at the high channel.</p> <p>No radiated spurious emissions were detected above 18GHz</p>



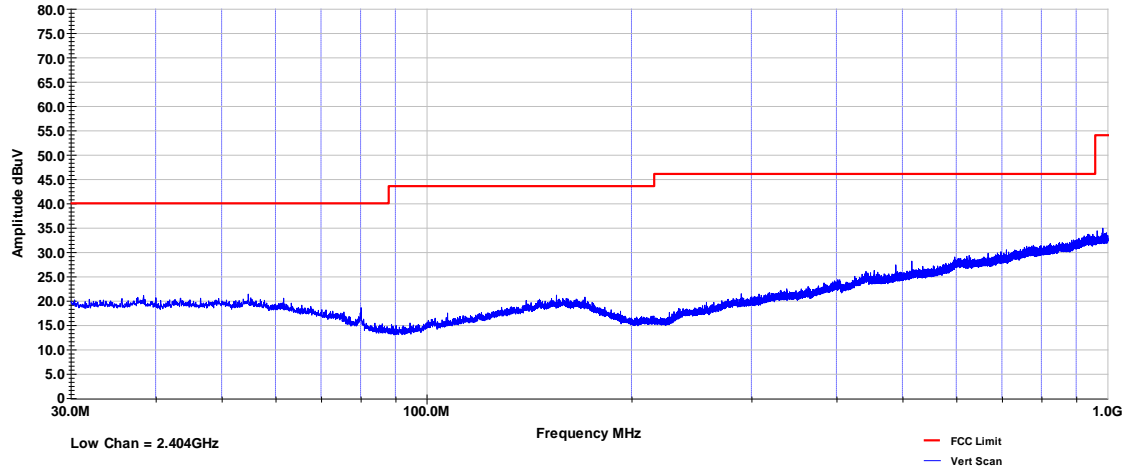
3M Company
Radiated Emissions Prescan
FCC Part 15 209, Horizontal

Project # - RE1908179
Model # - TR-600 Rev C.
Serial # - Nordic Prototype
EUT Power - 11.1 VDC Li-Ion Battery

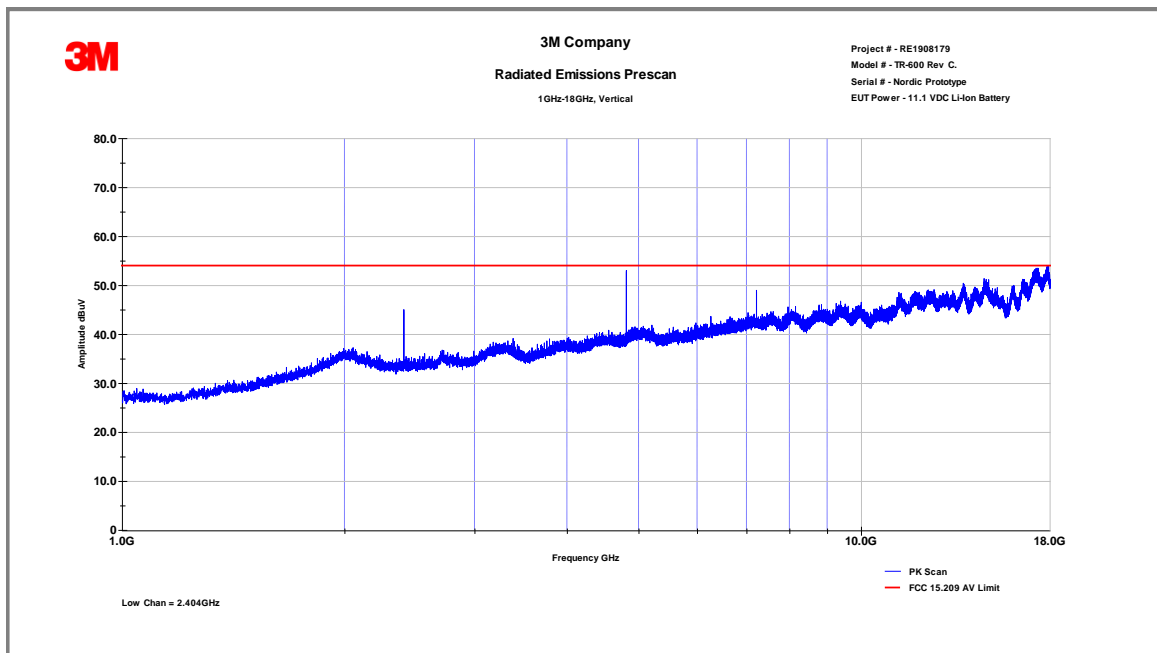
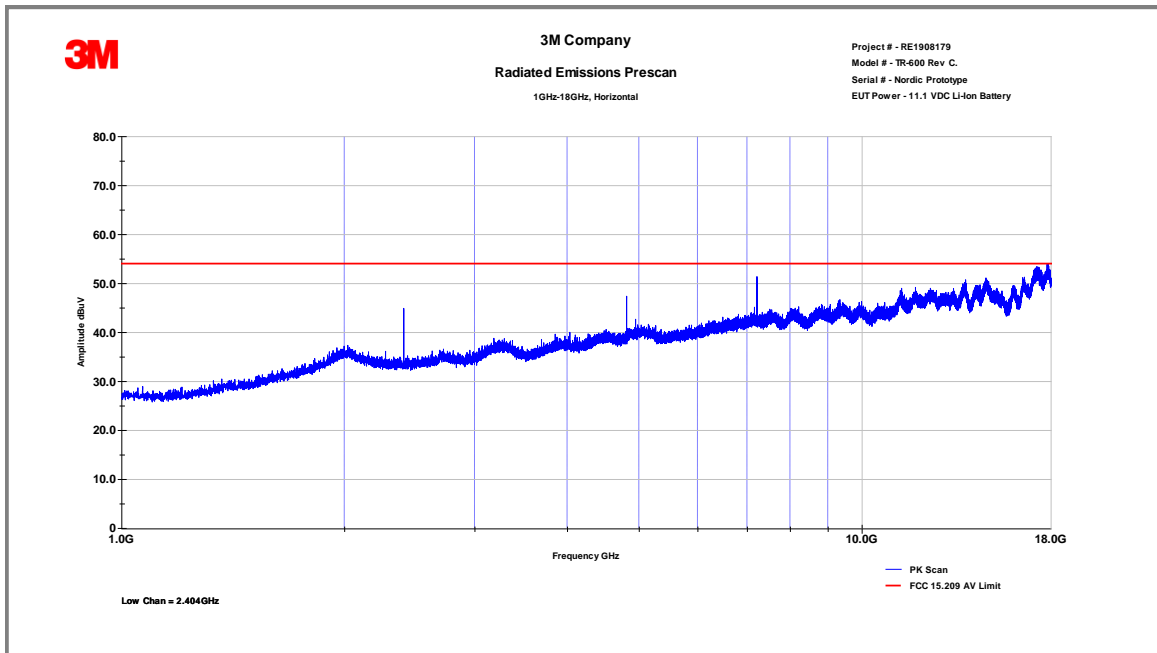


3M Company
Radiated Emissions Prescan
FCC Part 15 209, Vertical

Project # - RE1908179
Model # - TR-600 Rev C.
Serial # - Nordic Prototype
EUT Power - 11.1 VDC Li-Ion Battery



FCC Part 15.209 Radiated Emissions in restricted band – Low Channel

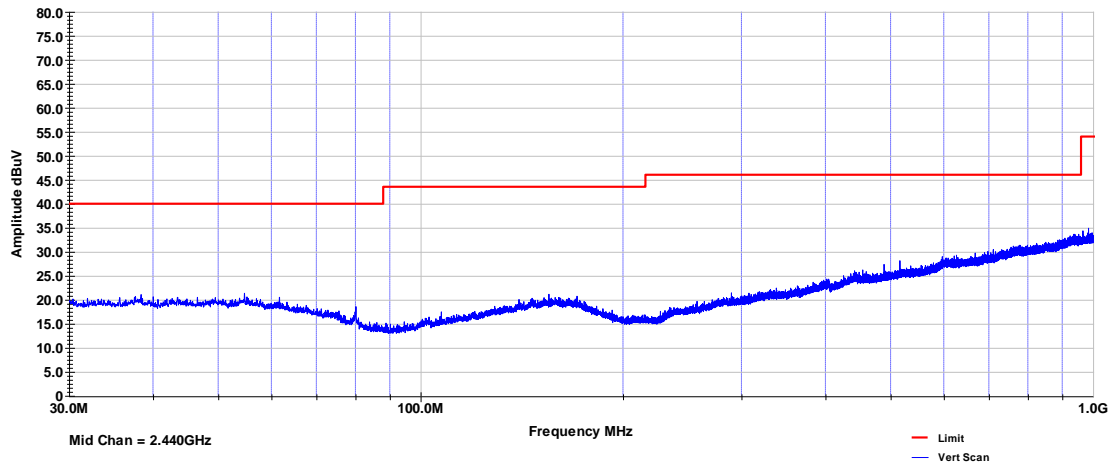


FCC Part 15.209 Radiated Emissions in restricted band – Low Channel



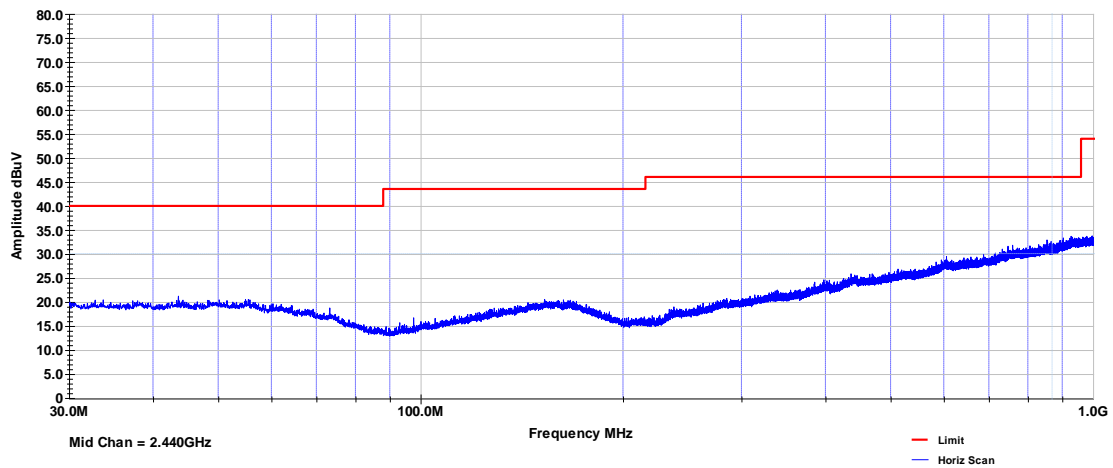
3M Company
Radiated Emissions Prescan
 FCC Part 15 209, Vertical

Project # - RE1908179
 Model # - TR-600 Rev C.
 Serial # - Nordic Prototype
 EUT Power - 11.1 VDC Li-Ion Battery

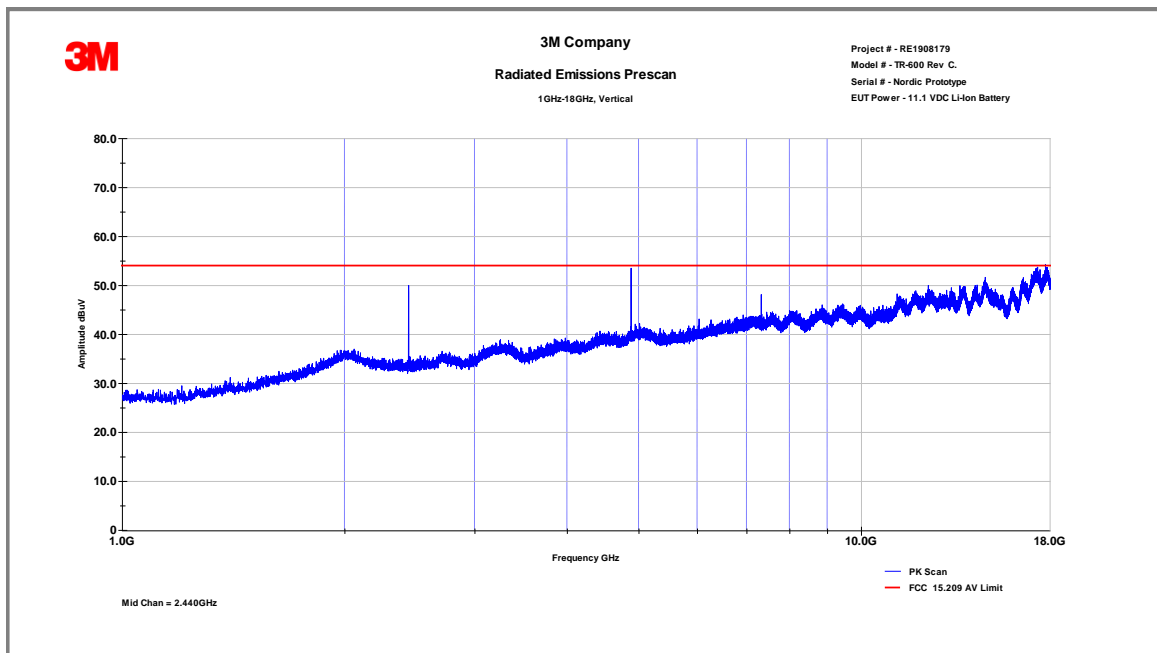
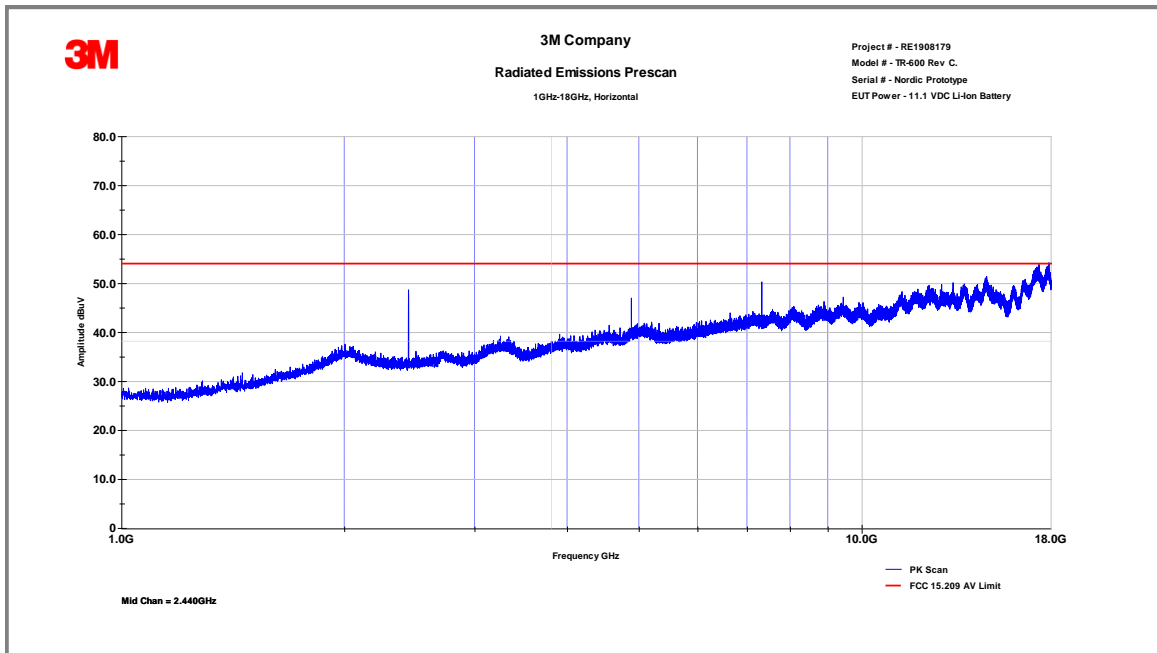


3M Company
Radiated Emissions Prescan
 FCC Part 15 209, Horizontal

Project # - RE1908179
 Model # - TR-600 Rev C.
 Serial # - Nordic Prototype
 EUT Power - 11.1 VDC Li-Ion Battery



FCC Part 15.209 Radiated Emissions in restricted band – Mid Channel

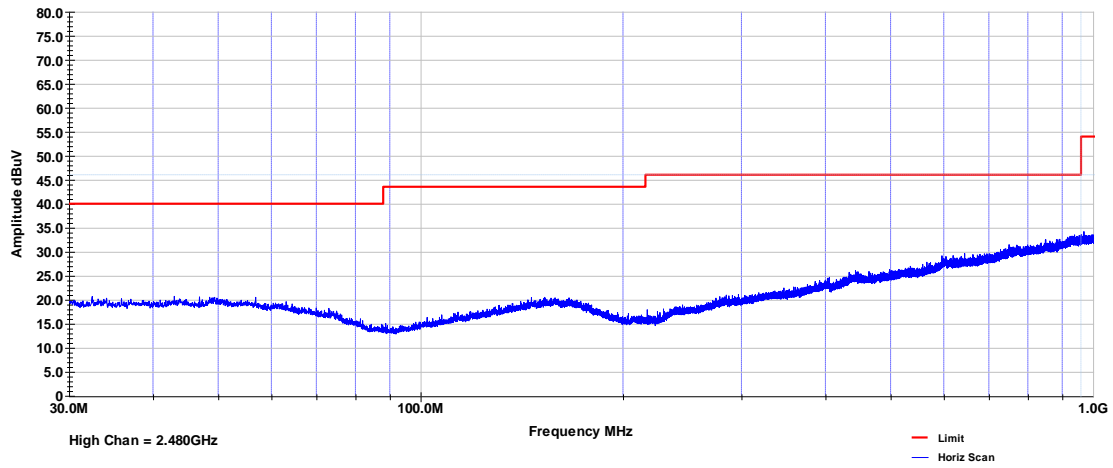


FCC Part 15.209 Radiated Emissions in restricted band – Mid Channel



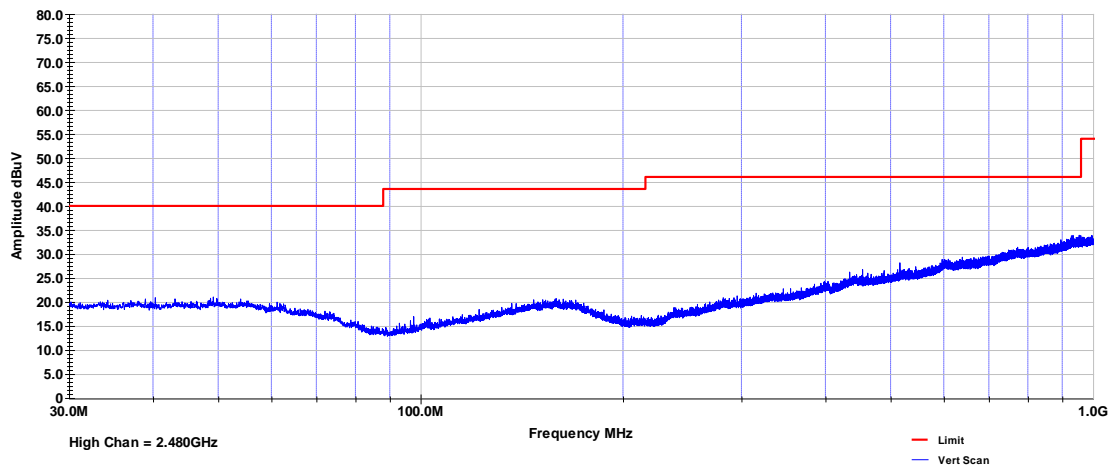
3M Company
Radiated Emissions Prescan
FCC Part 15 209, Horizontal

Project # - RE1908179
Model # - TR-600 Rev C.
Serial # - Nordic Prototype
EUT Power - 11.1 VDC Li-Ion Battery

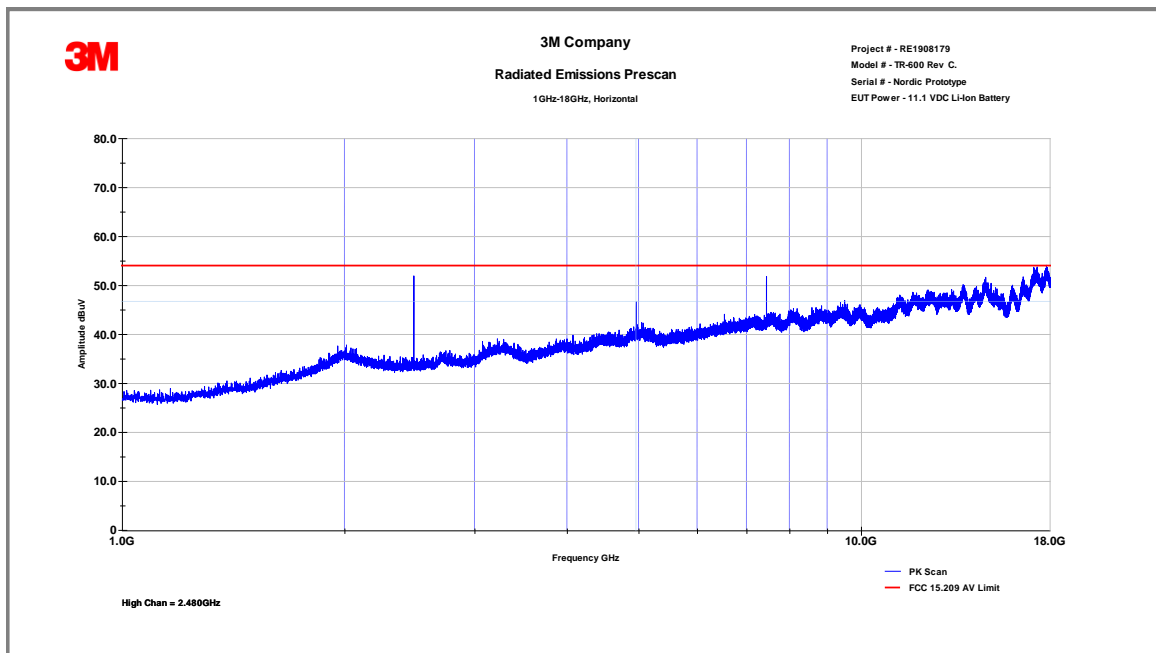
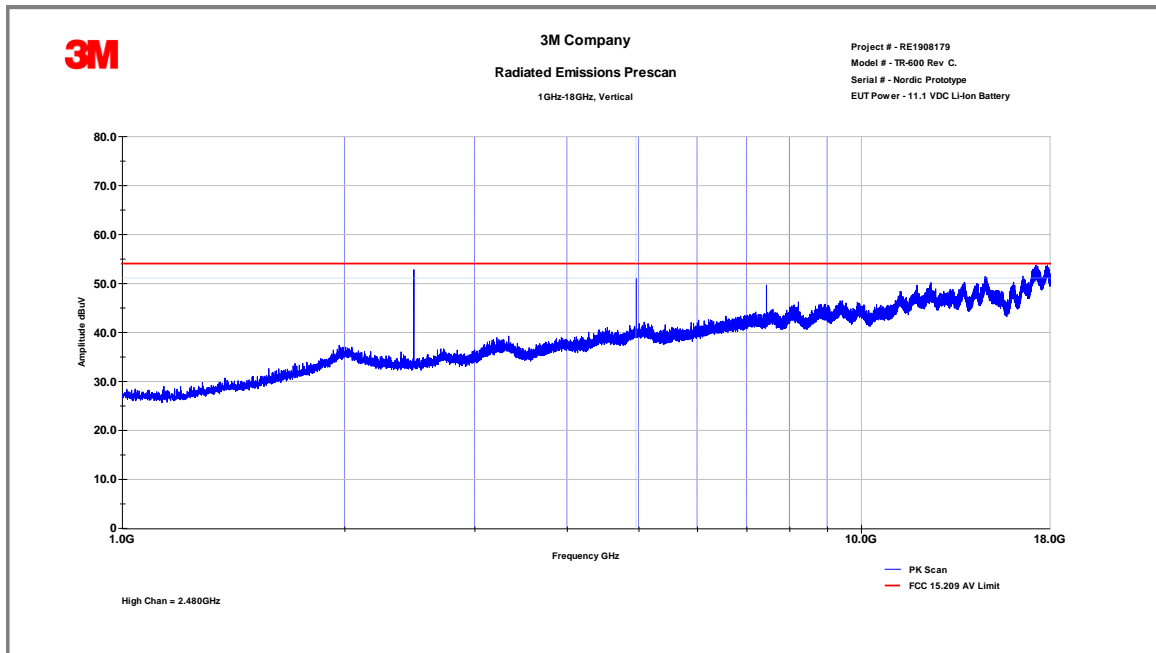


3M Company
Radiated Emissions Prescan
FCC Part 15 209, Vertical

Project # - RE1908179
Model # - TR-600 Rev C.
Serial # - Nordic Prototype
EUT Power - 11.1 VDC Li-Ion Battery



FCC Part 15.209 Radiated Emissions in restricted band – High Channel



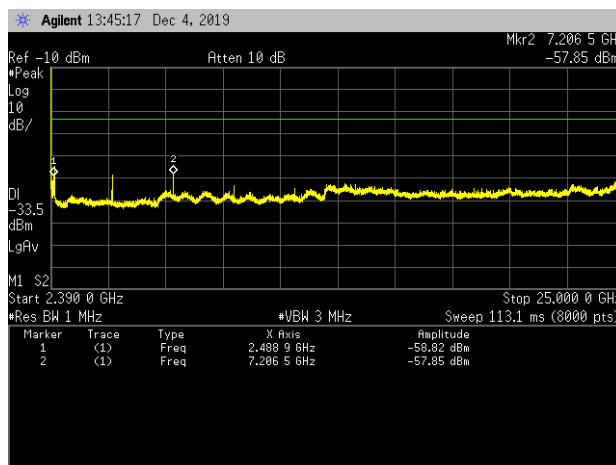
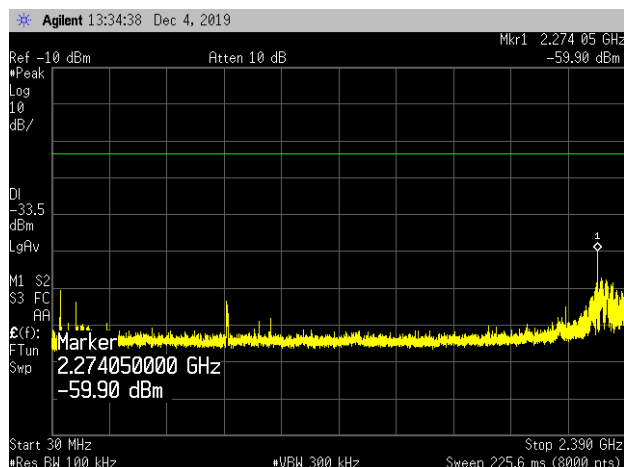
FCC Part 15.209 Radiated Emissions in restricted band – High Channel

[illegible]

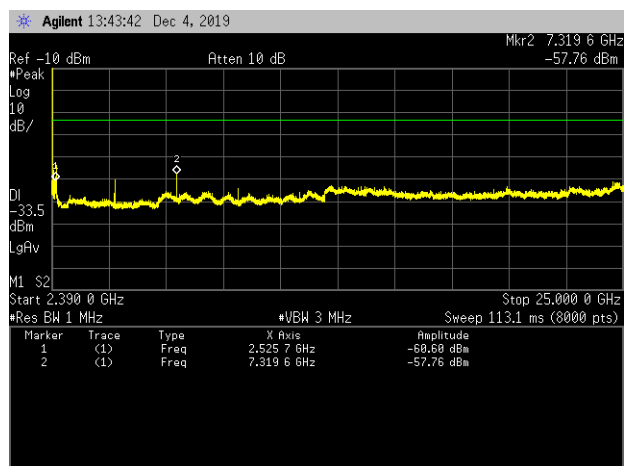
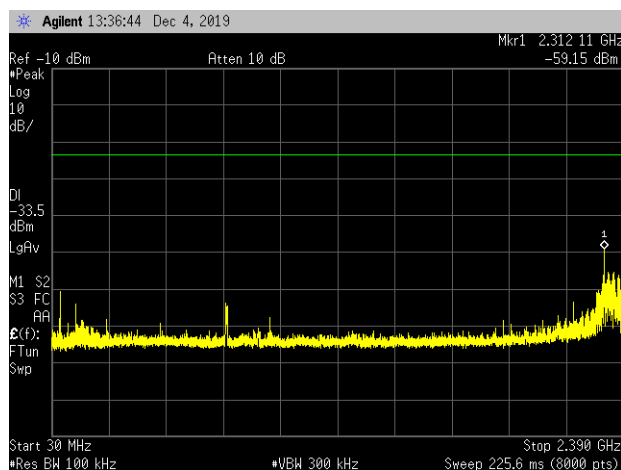


4.5	Radiated Emissions in non-restricted band		
Method:	The measurements were made with transmitter set to transmit continuously low, medium and high channels.		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2013 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input type="checkbox"/>	Measurement Point <input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated	
Frequency Range:	<input checked="" type="checkbox"/> 2402.0-2480.0 MHz		
PSD Level in 100KHz:	<input checked="" type="checkbox"/> -3.6 dBm	Results:	
Limit:	<input checked="" type="checkbox"/> -23.6dBm (20dBc below Peak PSD level)	>51dBc	
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 11VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>		Date: 12/04/2019

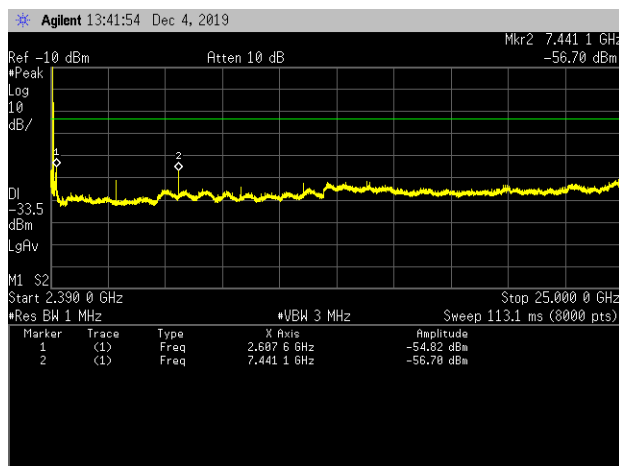
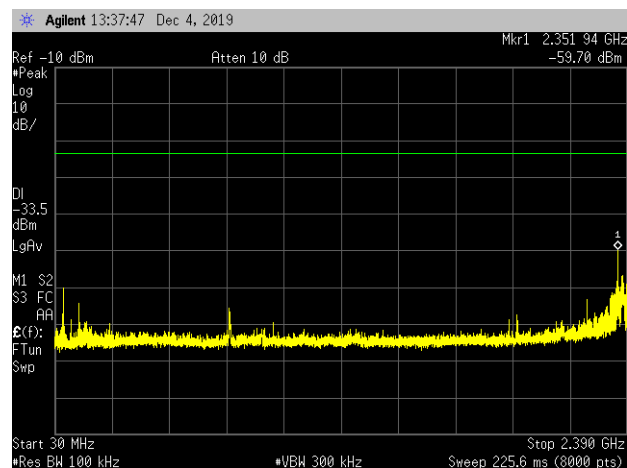
Note:



Conducted Spurious - Low Channel



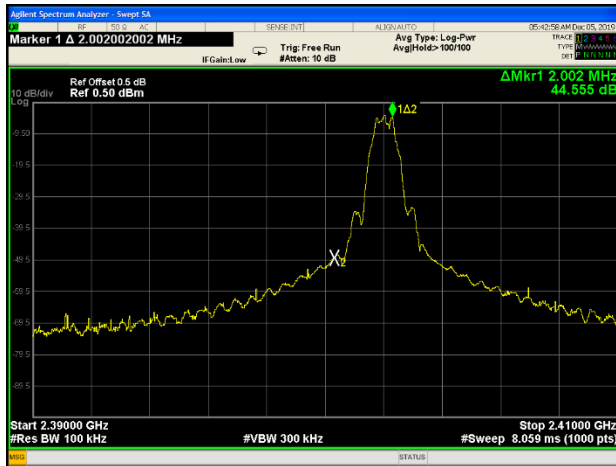
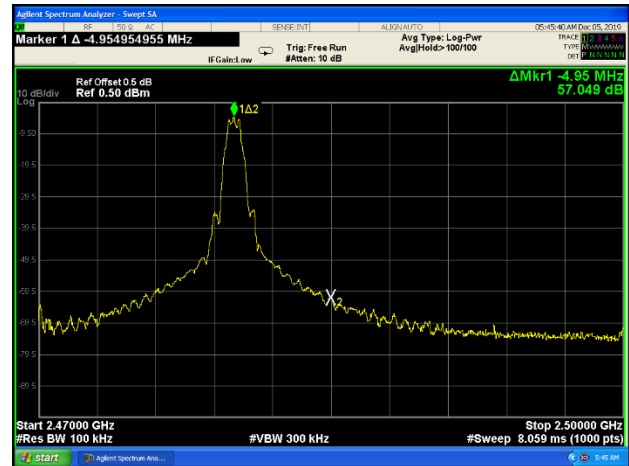
Conducted Spurious - Mid Channel



Conducted Spurious - High 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:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2013, Section 11.13.2 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input type="checkbox"/>	Measurement Point <input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated	
Frequency Range:	<input checked="" type="checkbox"/> 2402.0-2480.0 MHz		Results
Limit:	<input checked="" type="checkbox"/> >20dBc		Low Ch., 2402 MHz > 44.5dBc High Ch., 2480 MHz > 57dBc
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 11VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>		Date: 12/05/2019
Note:			

Band Edge - Low Channel
Center Freq. 2.400GHzBand Edge - High Channel
Center Freq. 2.4835GHz



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: <input type="checkbox"/>	Laboratory Ambient Temperature:			
	Relative Humidity:			
	Atmospheric Pressure:			
Reference Standard(s):	<input type="checkbox"/> RSS GEN/FCC 15.207 <input type="checkbox"/> ANSI C63.4:2014 <input type="checkbox"/> ANSI C63.10:2013		Measurement Point <input type="checkbox"/> Mains <input type="checkbox"/> Telecommunication ports <input type="checkbox"/>	
	Nominal Voltage: <input type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input type="checkbox"/>			
Test Personnel:		Date:		
Limits 15.207 – 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 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:	>10mm	
BT Antenna Gain (maximum):	1.15dBi (PCB trace)	
BLE Maximum Output Power at antenna terminal:	0.6mW(-2.45dBm)	
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:	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	71mW@ <5mm @<300MHz	
Note:		

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5.0	Test Equipment				
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Last Cal. Date	Check
Biconilog Antenna	Schaffner	CBL6112B	27491	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	EHA-51B	1213E	10/20/2019	<input type="checkbox"/>
EMI Receiver	Rohde & Schwarz	ESW26	101412	03/11/2019	<input checked="" type="checkbox"/>
Signal Analyzer	Agilent	N9000A	MY53031040	10/20/2019	<input checked="" type="checkbox"/>
EMI Receiver	Agilent	E4448A	1530975	10/20/2019	<input checked="" type="checkbox"/>
LISN	TESEQ	NNB51	1130	10/20/2019	<input type="checkbox"/>
Coaxial Cable	Insulated Wire	2803	CBL2039	10/20/2019	<input checked="" type="checkbox"/>
EMC Software	ETS-Lindgren	TILE 7		N/A	<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	0311/2020	RE1908179-1	Original Issue