

# EMC TEST REPORT



**Standard(s):**

**47 CFR FCC Parts 15.247  
RSS 247, Issue 2, 2017**

**FCC ID: DGFPSDTR602CX1  
IC: 458A-PSDTR602CX1**

**Class II Permissive Change**

**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: RE1908179-3  
Report Issue Date: July 8, 2020**

**Report Prepared by:**

**Signature:** *Yuriy Litvinov*  
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**Tested by:  
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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 | 15.247(b)(3)/<br>RSS 247, 5.4(d) | Maximum Peak Conducted Output Power   | <b>pass</b> |          |
| 4.2 | 15.209/15.109/<br>RSS Gen, 8.9   | Radiated Emissions in restricted band | <b>pass</b> |          |
| 4.3 | Part 15.207/RSS-Gen, 8.8         | Conducted Emissions                   | <b>N/A</b>  | See note |
| 4.4 | Part 15.247(i)/RSS 102           | RF Exposure Compliance                | <b>pass</b> |          |
|     |                                  |                                       |             |          |

**Note:**

Device is powered from the battery.  
Class II PC testing to update RF circuitry passive components

## 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  |  |                                 |   |
|--|---|--|---------------------------------|---|
| <b>Description:</b>                        | Powered Air Purifying Respirator for use in rugged environments such as industrial, demolition, grinding, metal finishing and casting operations. |  |                                 |   |
| <b>Model(s):</b>                           | TR-600-CX   |  |                                 |   |
| <b>Serial number:</b>                      | N/A   |  |                                 |   |
| <b>Contact:</b>                            | <a href="#">Peter Brudzinski</a>  |  |                                 |   |
| <b>Phone:</b>                              | 651 736 9053  |  |                                 |   |
| <b>3M Division:</b>                        | Personal Safety   |  |                                 |   |
| <b>Modifications and Special Measures:</b> | none  |  |                                 |   |
| <b>Frequency Range:</b>                    | 2402.0-2480.0 MHz   |  |                                 |   |
| <b>Channel No.:</b>                        | 39  |  |                                 |   |
| <b>Modulation Type:</b>                    | GFSK  |  |                                 |   |
| <b>Output Power EIRP:</b>                  | -3.25dBm (0.5mW)  |  |                                 |   |
| <b>Antenna Type:</b>                       | Internal PCB Antenna  |  |                                 |   |
| <b>Antenna Gain:</b>                       | 1.15 dBi  |  |                                 |   |
| <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"/> 11.1VDC |
|  | <b>Phase:</b>   | <input type="checkbox"/> 1ph             | <input type="checkbox"/> 3ph    | <input checked="" type="checkbox"/> Battery |
|  | <b>Frequency:</b>   | <input type="checkbox"/> 50Hz            | <input type="checkbox"/> 60Hz   |   |
|  | <b>Current:</b>   |  |                                 |   |
| <b>Test Dates:</b>                         | 07/06-07/07/2020  |  |                                 |   |
| <b>Received Date:</b>                      | 11/21/2019  |  |                                 |   |
| <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   | 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   | Device programming using Nordic Studio BT software for continues transmission of modulated carrier at maximum rated RF output power and Duty Cycle. |



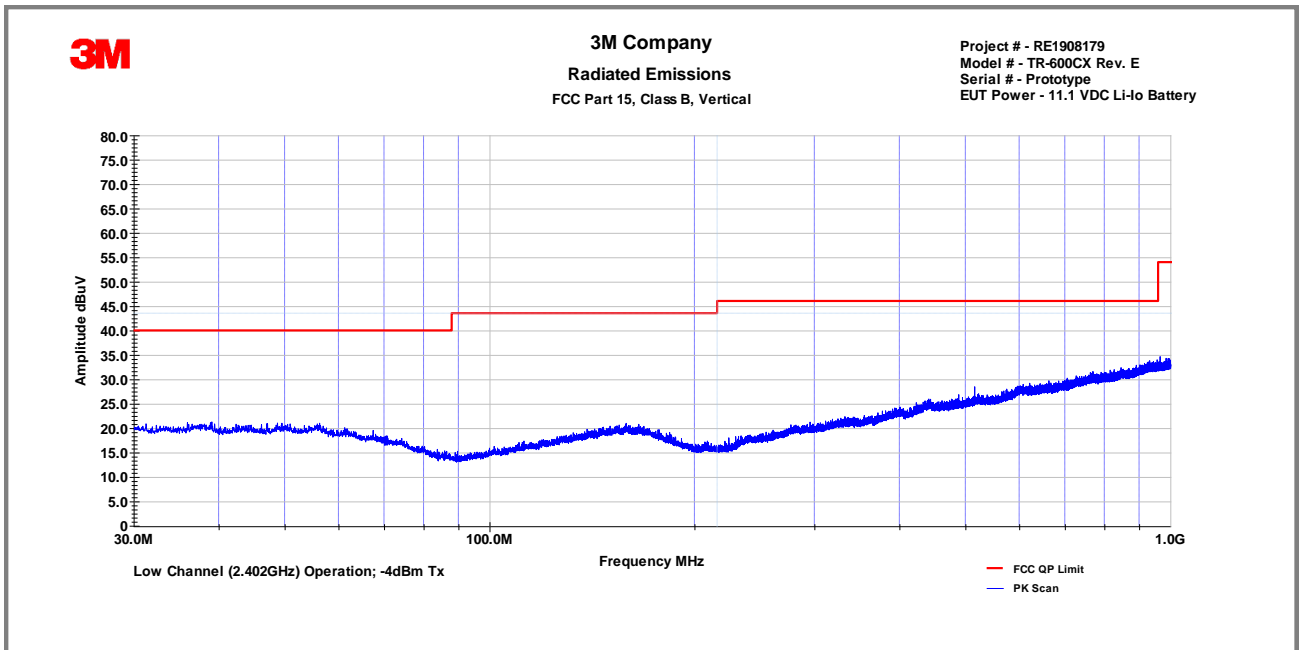
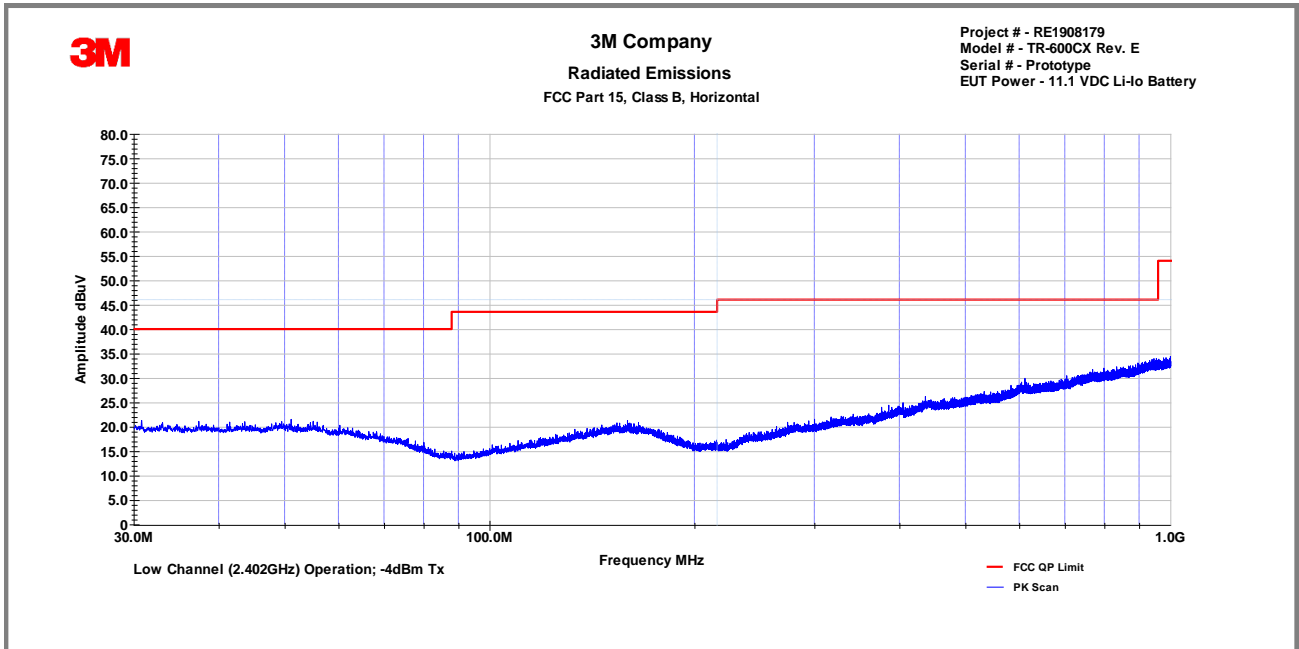
## 4.0 Test Conditions and Results

| 4.21                          | Maximum Output Power   |  |             |
|-------------------------------|--|--|-------------|
| <b>Method:</b>                | 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   |             |
| <b>Reference Standard(s):</b> | <input checked="" type="checkbox"/> ANSI C63.10:2013<br><input checked="" type="checkbox"/> FCC Part 15.247/RSS 247<br><input checked="" type="checkbox"/> KDB 558074                                      | <b>Measurement Point</b><br><input checked="" type="checkbox"/> Conducted<br><input type="checkbox"/> Radiated at 3 meters |             |
| <b>Frequency Range:</b>       | <input checked="" type="checkbox"/> 2402.0 – 2480.0 MHz  |  |             |
| <b>Antenna Gain:</b>          | 1.15 dBi   | <b>Maximum Conducted Peak Power (dBm):</b>   |             |
| <b>Limit:</b>                 | 30 dBm   | Ch(0):-4.4   | Ch(19):-5.1 |
| <b>Nominal Voltage:</b>       | <input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 11VDC  |  |             |
| <b>Test Personnel:</b>        | Yuriy Litvinov <i>Yuriy Litvinov</i>   | <b>Date:</b> 07/07/2020  |             |
| <b>Note:</b>                  | EIRP (dBm) = Conducted Power (dBm) +Antenna Gain (dBi)= -4.4+1.15= -3.25dBm  |  |             |



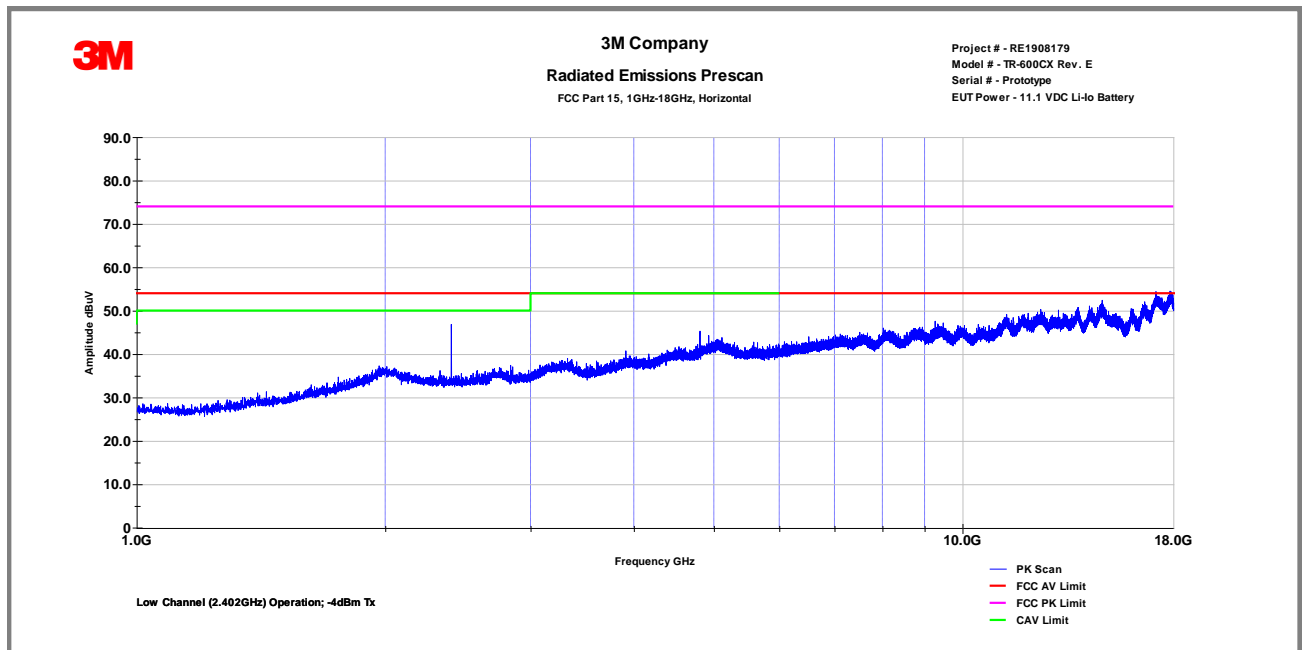
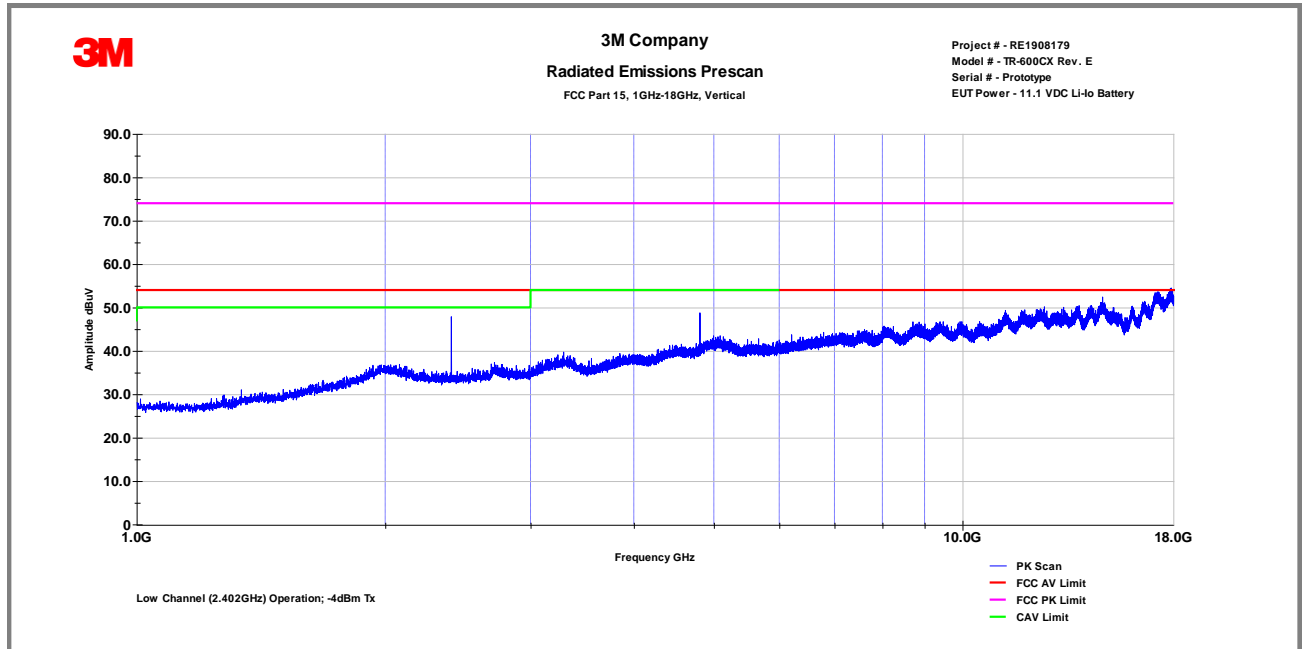
| 4.2   |   | Radiated Emissions in restricted band |     |                         |             |
|---|---|---------------------------------------|-----|-------------------------|-------------|
| <b>Method:</b>  | Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4 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. |                                       |     |                         |             |
| <b>Test Verification:</b> <input checked="" type="checkbox"/> | Laboratory Ambient Temperature:   | 23°C                                  |     |                         |             |
|   | Relative Humidity:  | 55%                                   |     |                         |             |
|   | Atmospheric Pressure:   | 1011 mbars                            |     |                         |             |
| <b>Reference Standard(s):</b>                                 | <input checked="" type="checkbox"/> ANSI C63.10:2013, Section 11.12.1   | <b>Measurement Distance</b>           |     |                         |             |
|   | <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247<br><input type="checkbox"/>   |                                       |     |                         |             |
| <b>Frequency Range:</b>                                       | <input checked="" type="checkbox"/> 30 MHz to 1 GHz<br><input checked="" type="checkbox"/> 1 GHz to 25 GHz  |                                       |     |                         |             |
| <b>Nominal Voltage:</b>                                       | <input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 11VDC   |                                       |     |                         |             |
| <b>Test Personnel:</b>  | Keith Schwartz <i>KS</i>  |                                       |     | <b>Date:</b> 07/06/2020 |             |
| <b>Limits -15.209</b>   |   |                                       |     |                         |             |
| 0.009-0.490   |   | 2400/F(KHz)                           | 300 | 300                     | <b>N/A</b>  |
| 0.490-1.705   | 24000/F(KHz)  |                                       | 30  | 30                      | <b>N/A</b>  |
| 1.705-30  | 30  |                                       | 30  | 30                      | <b>N/A</b>  |
| 30 to 88  | 40  |                                       |     | 3                       | <b>pass</b> |
| 88 to 216   | 43.5  |                                       |     | 3                       | <b>pass</b> |
| 216 to 960  | 46  |                                       |     | 3                       | <b>pass</b> |
| Above 960   |   | 54                                    |     | 3                       | <b>pass</b> |

| <b>Modifications:</b> |  |
|-----------------------|--|
| <b>Note:</b>          | <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>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> <p>Spurious emissions were tested at the Low and High Channel as a worst case.</p> |



FCC Part 15.209 Radiated Emissions in restricted band – Low Channel



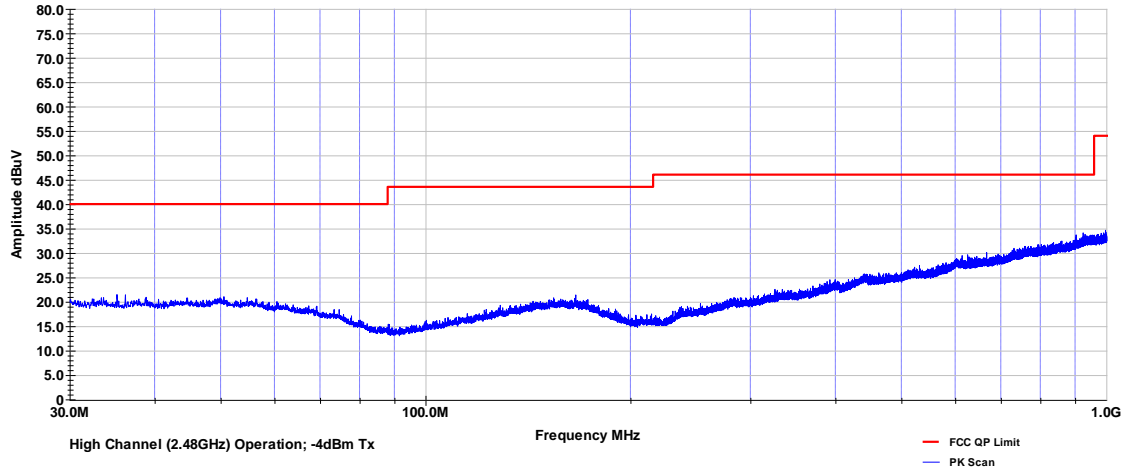


FCC Part 15.209 Radiated Emissions in restricted band – Low Channel



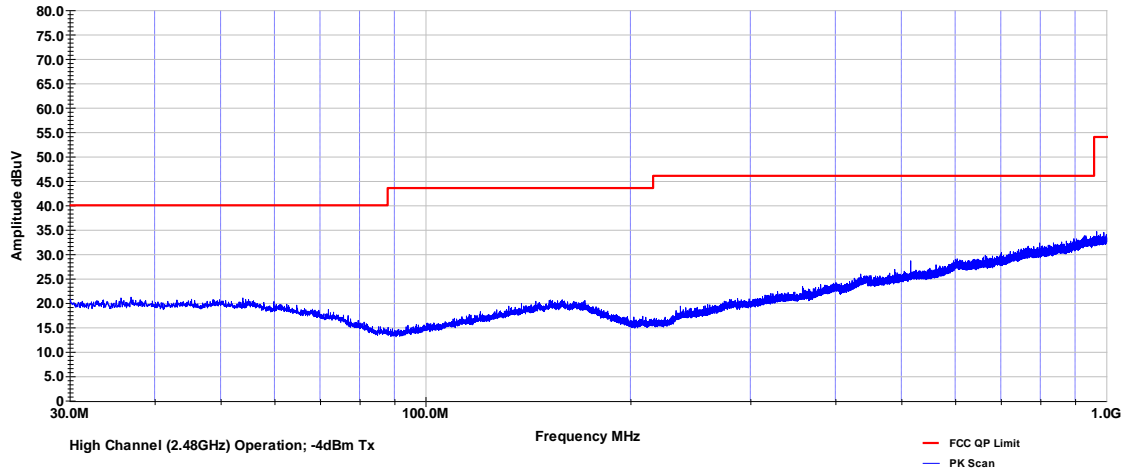
3M Company  
Radiated Emissions  
FCC Part 15, Class B, Horizontal

Project # - RE1908179  
Model # - TR-600CX Rev. E  
Serial # - Prototype  
EUT Power - 11.1 VDC Li-Io Battery

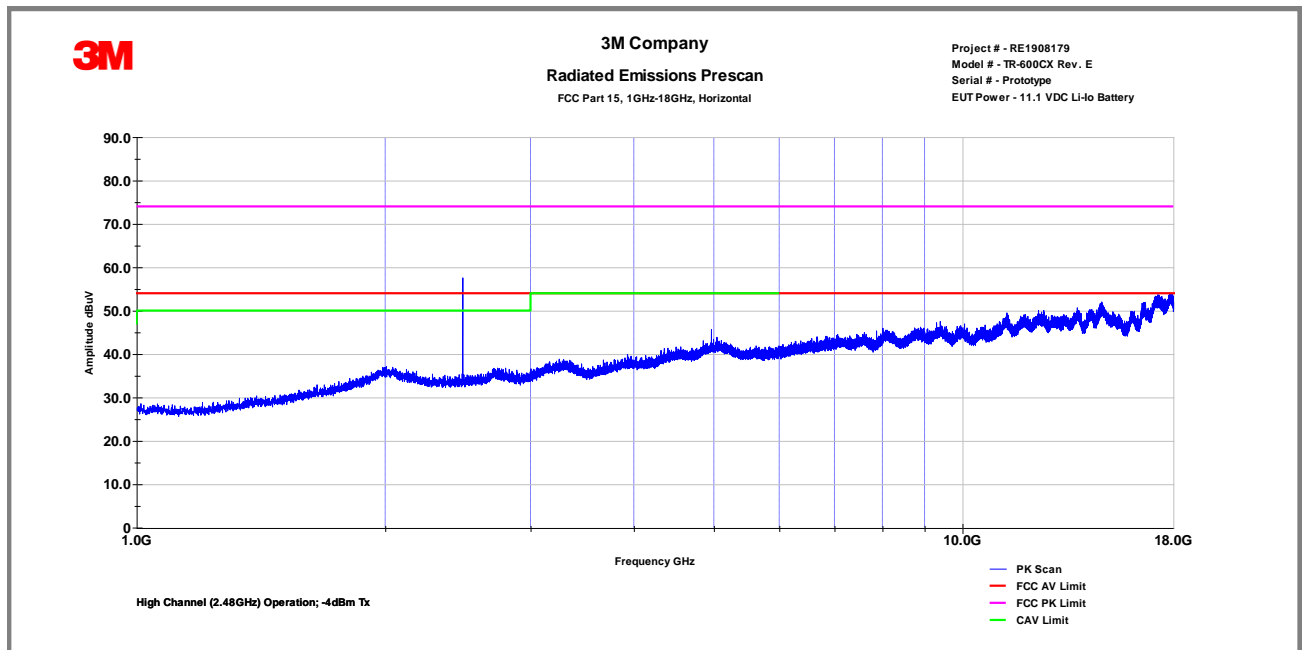
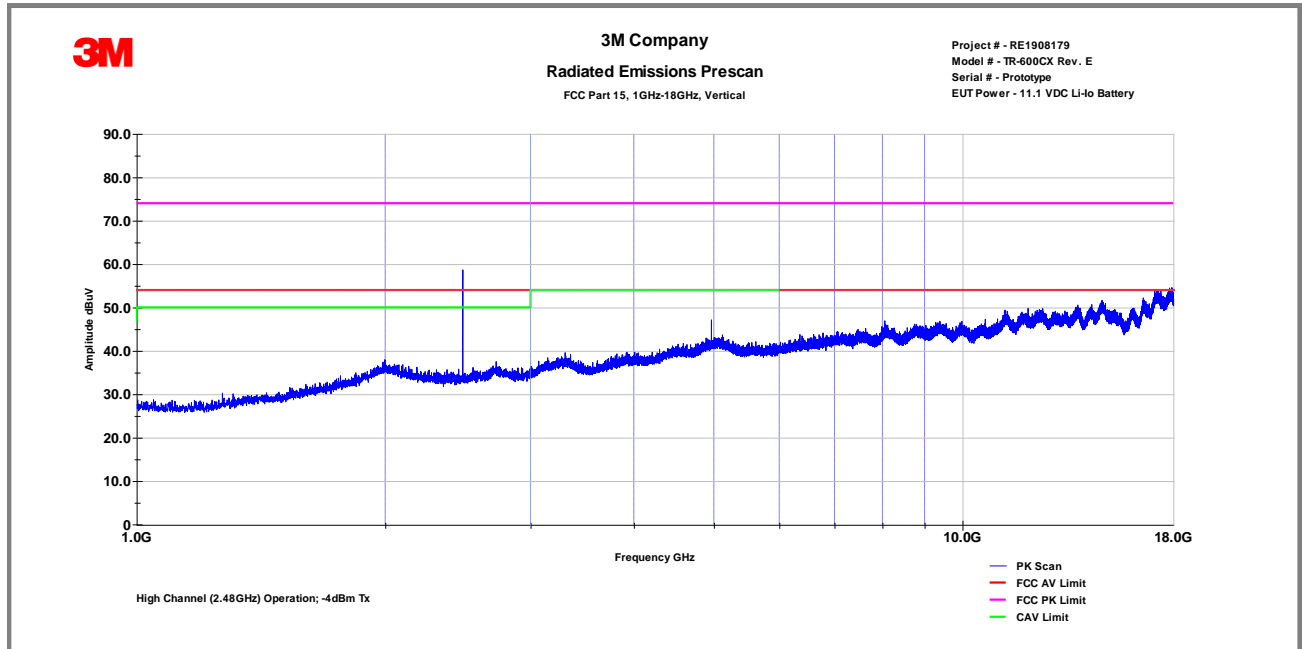


3M Company  
Radiated Emissions  
FCC Part 15, Class B, Vertical

Project # - RE1908179  
Model # - TR-600CX Rev. E  
Serial # - Prototype  
EUT Power - 11.1 VDC Li-Io Battery



FCC Part 15.209 Radiated Emissions in restricted band – High Channel



FCC Part 15.209 Radiated Emissions in restricted band – High Channel



## Tables - Radiated Emissions in restricted band

| Pol    | Frequency (MHz)  | Peak dB $\mu$ V/m | AVG dB $\mu$ V/m | Total CF dB | Net Peak dB $\mu$ V/m | Net AVE dB $\mu$ V/m | PK Limit dB $\mu$ V/m | AVE Limit dB $\mu$ V/m | PK Margin dB | AVG Margin dB |
|--------|--|-------------------|------------------|-------------|-----------------------|----------------------|-----------------------|------------------------|--------------|---------------|
| V      | 4808.09  | 54.70             | 51.3             | -5.60       | 49.10                 | 45.70                | 74.00                 | 54.00                  | -24.90       | -8.30         |
| H      | 4808.09  | 53.00             | 48.2             | -5.60       | 47.40                 | 42.60                | 74.00                 | 54.00                  | -26.60       | -11.40        |
| V      | 7212.01  | 50.50             | 42.8             | -3.50       | 47.00                 | 39.30                | 74.00                 | 54.00                  | -27.00       | -14.70        |
| H      | 7212.01  | 50.60             | 42.6             | -3.50       | 47.10                 | 39.10                | 74.00                 | 54.00                  | -26.90       | -14.90        |
| V      | 9616.12  | 48.10             | 39.30            | -1.70       | 46.40                 | 37.60                | 74.00                 | 54.00                  | -27.60       | -16.40        |
| H      | 9616.12  | 45.80             | 38.40            | -1.70       | 44.10                 | 36.70                | 74.00                 | 54.00                  | -29.90       | -17.30        |
| Notes: | Net Reading (dB $\mu$ V) = Reading (dB $\mu$ V) + (Antenna with amp CF(dB)+Cable CF(dB)) |                   |                  |             |                       |                      |                       |                        |              |               |
|        | Low Channel  |                   |                  |             |                       |                      |                       |                        |              |               |

| Pol    | Frequency (MHz)  | Peak dB $\mu$ V/m | AVG dB $\mu$ V/m | Total CF dB | Net Peak dB $\mu$ V/m | Net AVE dB $\mu$ V/m | PK Limit dB $\mu$ V/m | AVE Limit dB $\mu$ V/m | PK Margin dB | AVG Margin dB |
|--------|--|-------------------|------------------|-------------|-----------------------|----------------------|-----------------------|------------------------|--------------|---------------|
| V      | 2483.50  | 48.70             | 38.80            | -13.70      | 35.00                 | 25.10                | 74.00                 | 54.00                  | -39.00       | -28.90        |
| H      | 2483.50  | 48.70             | 38.80            | -13.70      | -5.16                 | -5.16                | 74.00                 | 54.00                  | -79.16       | -59.16        |
| V      | 4960.03  | 52.20             | 46.80            | -4.60       | 47.60                 | 42.20                | 74.00                 | 54.00                  | -26.40       | -11.80        |
| H      | 4960.03  | 53.90             | 49.90            | -4.60       | 49.30                 | 45.30                | 74.00                 | 54.00                  | -24.70       | -8.70         |
| V      | 7440.00  | 50.42             | 41.80            | -2.78       | 47.64                 | 39.02                | 74.00                 | 54.00                  | -26.36       | -14.98        |
| H      | 7440.00  | 49.10             | 40.00            | -2.78       | 46.32                 | 37.22                | 74.00                 | 54.00                  | -27.68       | -16.78        |
| V      | 9920.44  | 49.10             | 39.70            | -0.90       | 48.20                 | 38.80                | 74.00                 | 54.00                  | -25.80       | -15.20        |
| H      | 9920.44  | 50.50             | 42.50            | -0.90       | 49.60                 | 41.60                | 74.00                 | 54.00                  | -24.40       | -12.40        |
| Notes: | Net Reading (dB $\mu$ V) = Reading (dB $\mu$ V) + (Antenna with amp CF(dB)+Cable CF(dB)) |                   |                  |             |                       |                      |                       |                        |              |               |
|        | High Channel   |                   |                  |             |                       |                      |                       |                        |              |               |



|  |   |          |  |     |
|--|---|----------|--|-----|
| <b>4.3</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"/> RSS GEN/FCC 15.207   |          | <b>Measurement Point</b><br><input type="checkbox"/> Mains<br><input type="checkbox"/> Telecommunication ports<br><input type="checkbox"/> |     |
|  | <input type="checkbox"/> ANSI C63.4:2014  |          |  |     |
|  | <input type="checkbox"/> ANSI C63.10:2013   |          |  |     |
| <b>Nominal Voltage:</b>                            | <input type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input type="checkbox"/>  |          |  |     |
| <b>Test Personnel:</b>                             |   |          | <b>Date:</b>   |     |
| <b>Limits 15.207 – AC Mains</b>                    |   |          |  |     |
| 0.15 to 0.50                                       | 66 to 56  | 56 to 46 | <b>N/A</b>   | AMN |
| 0.50 to 5  | 56  | 46       | <b>N/A</b>   | AMN |
| 5 to 30  | 60  | 50       | <b>N/A</b>   | AMN |

|                       |  |
|-----------------------|--|
| <b>Modifications:</b> |  |
| <b>Note:</b>          |  |



| 4.4 RF Exposure Evaluation   |  |
|--|--|
| Reference Standard(s):   | <input checked="" type="checkbox"/> KDB 447498<br><input checked="" type="checkbox"/> RSS 102, Issue 5<br><input checked="" type="checkbox"/><br><input type="checkbox"/> MPE<br><input type="checkbox"/> SAR Evaluation<br><input checked="" type="checkbox"/> SAR Test Exclusion |
| Frequency Range:   | <input checked="" type="checkbox"/> 2402-2480.0MHz<br><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: 0.5mW(-3.25dBm)  |  |
| RFID Maximum Power: M24LR RF Operating Current 0.0002A (50 Ohm load)<br>The power calculation is $P = 0.0002A^2 \times 50 \text{ Ohm} = 0.2mW$ |  |
| RF Exposure Conditions: Belt-worn  |  |
| Power Density: N/A   |  |
| <b>SAR Test Exclusion Threshold</b>  |  |
| 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:  |  |



| 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"/> |
| <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              | 07/09/2020              | RE1908179-3   | Original Issue |
|                |                         |               |                |
|                |                         |               |                |