EMC TEST REPORT

NVLAP Lab Code 200033-0

Standard(s):

47 CFR FCC Part 15.247 RSS 247, Issue 3, 2023

FCC ID:DGFPSD225B IC:458A-PSD225B

Product: 3M™ Scott™ Advanced Electronics Gateway

Model (HVIN): 70-0020-1020-8

Company Name: 3M Company

Address:

Fire & SCBA Solutions 4320 Goldmine Road, Monroe, NC 28110

Report Number: HRE202105206-1 Report Issue Date: March 25, 2024

Report Prepared by:

Signature: Yuriy Litrinov Lead EMC Engineer

Tested by: 3M Hardgoods Regulatory Engineering Laboratory 410 E. Fillmore Avenue, Building 76 St. Paul, Minnesota 55107-1208, USA



Report Number: HRE202105206-1 Date: March 25, 2024

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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.

	Requirement – Test	Test Description	Result	Comments
4.1	FCC Part 15.247(a)(2)/ RSS-247(5.2(a))/RSS-Gen (6.7)	DTS Bandwidth	pass	
4.2	FCC Part 15.247(b)(3)/ RSS-247(5.4(d))	Maximum Peak Conducted Output Power	pass	
4.3	FCC Part 15.247(e)/ RSS-247(5.2(b))	Maximum Power Spectral Density level	pass	
4.4	FCC Part 15.209 RSS-Gen, 8.9	Radiated Emissions in restricted band	pass	
4.5	FCC Part 15.247(d)/ RSS-247(5.5)	Radiated Emissions in non-restricted band	pass	
4.6	FCC Part 15.247(d)(1)/ RSS-247(5.5)	DTS Band-edge Emissions Measurements	pass	
4.7	FCC Part 15.207/ RSS-Gen (8.8)	Conducted Emissions	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
RF frequency	±3 × 10 ⁻⁸
RF power, conducted	1.4 dB
RF Power Spectral Density	0.96 dB

1.2 Test Facility

	ISO/IEC 17025:2017, NVLAP LAB CODE: 200033-0
Test Facility Accreditations:	FCC OET Designation Number: US5320
71001041141101101	ISED CAB identifier: US0012



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2.0 Equipment Description

3M

2.1	Equipment Under Test				
Description:		The Valor Gateway is a device used to "connect" a handheld Toughbook tablet or computer to SCBA (a self-contained breathing apparatus) telemetry systems worn by firefighters inside a fire scene. It contains LORA 915MHz, Bluetooth (Low Energy) 2.4GHz and RFID 13.56MHz transmitters.			
	Model(s):	70-0020-1020-8			
	Serial number:	N/A			
	3M Division:	Personal Safety			
Modifi	cations and Special Measures:	none			
	Frequency Range:	2402.0-2480.0 MH	l z		
	Channel No.:	39			
	Modulation Type:	GFSK			
FCC Classification:		Digital Transmission System (DTS)			
Output Power EIRP:		7.2dBm (5.3mW)			
Anteni	na Type and Antenna Assembly	☐ External			□ Dedicated
	Gain:	⊠ 2dBi	☐ Declared by the Manufacturer		☐ Measured
	Test Deviations or Exclusions	☐ Yes	⊠ No		
		Voltage:	☐ 120VAC	☐ 230VAC	⊠ 5.0VDC
	Rated Power:	Phase:	☐ 1ph	☐ 3ph	⊠ via USB-C
	Rated Power.	Frequency:	☐ 50Hz	☐ 60Hz	
		Current:	N/A		
Test Dates:		08/16-08/24/2021			
	Received Date:	08/16/2021			
	Received Conditions:	Poor	r ⊠ Good		
	Received Conditions:		☐ Production		



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3.0 EUT Configuration

3.1 System Configuration

No.	Product Type	Manufacturer	Model	Comments
1	Valor Gateway	3M	70-0020-1020-8	
2	USB Power Supply	Samsung	ETA-U90AWS	Support Equipment

3.2 Input/Output Ports of EUT

No	o. Description	Туре	Comments
1	DC Power	USB-C	
2	2		

3.3 Cables

No.	Description	Туре	Length	Shielding	Comments
1	USB-C	USB 2.0	1m	Yes	
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		Transferring of various data via Bluetooth radio to SCBA telemetry systems.
2		

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 lowest (0), middle (19) and highest (39) channels
3	Device programming using YAT v2.4.1 (Yet Another Terminal) software for continues transmission of modulated carrier at maximum rated RF output power and Duty Cycle.



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4.0 Test Conditions and Results

4.1	DTS Bandwidth	OTS Bandwidth						
		Laboratory Ambient Temperature:	23°C					
		Relative Humidity:	48%					
		Atmospheric Pressure:	1011 mbars					
Reference Standard(s):		☑ ANSI C63.10:2020, Section 11.8.2☑ FCC Part 15.247/RSS 247☑ KDB 558074	Measurement Point ☐ Conducted ☐ Radiated					
Fre	equency Range:	⊠ 2402.0-2480.0 MHz	RBW = 100KHz VBW ≥ 3 x RBW					
N	lominal Voltage:	☐ 120VAC ☐ 5VDC						
	Test Personnel:	Yuriy Litvinov ywy didines	Date: 08/23/2021					

Frequency (MHz)	Data Rate	99% dB Bandwidth (KHz)	6 dB Bandwidth (KHz)	6dB OBW Limit (KHz)	Results
2402	1 Mbps	1068	689.5	> 500	pass
2440	1 Mbps	1068	686.6	> 500	pass
2480	1 Mbps	1069	686.9	> 500	pass





OBW - Low Channel

OBW - Mid Channel



OBW - High Channel

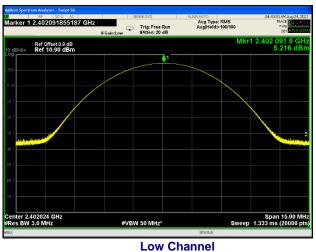


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4.2	Maximum Output	Maximum Output Power						
Method:		Measurements was performed with CW carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.						
		Laboratory Ambient Temperature:	23°C					
		Relative Humidity:	48%					
		Atmospheric Pressure:	1011 mbars					
Refe	erence Standard(s):	 ☒ ANSI C63.10:2020, Section 11.9 ☒ FCC Part 15.247/RSS 247 ☒ KDB 558074	Measurement Point ☑ Conducted ☐ Radiated at 3 meters					
	Frequency Range:	☑ 2402.0 – 2480.0 MHz	Naulated at 3 meters					
	Antenna Gain:	2.0dBi	Maximum Conducted Power (EIRP):					
	Limit:	30 dBm	7.2 dBm					
	Nominal Voltage:	☐ 120VAC ☐ 5VDC						
	Test Personnel:	Yuriy Litvinov Yuriy divinor	Date: 08/23/2021					

Note: EIRP (dBm) = Conducted Power (dBm) +Antenna Gain (dBi)= 5.2+2.0= 7.2dBm





Mid Channel



High Channel

4.3	Maximum Power	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					
Refere	ence Standard(s):	☑ ANSI C63.10:2020, Section 11.10.2☑ FCC Part 15.247/RSS 247☑ KDB 558074	Measurement Point ☐ Conducted ☐ Radiated at 3 meters					
F	requency Range:	☑ 2402.0 – 2480.0 MHz	PSD Results					
	PSD Limit:	8 dBm in any 3KHz band	-14.3 dBm					
	Nominal Voltage:	☐ 120VAC ☐ 5VDC						
	Test Personnel:	Yuriy Litvinov yuriy diwino	Date: 08/23/2021					





PSD Low Channel

PSD Mid Channel



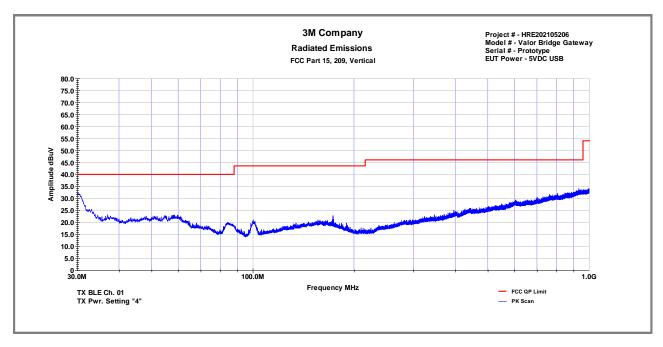
PSD High Channel

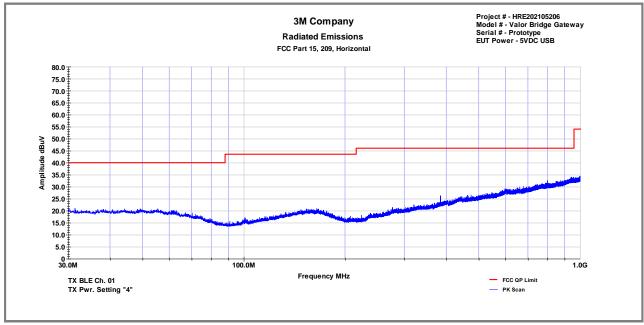


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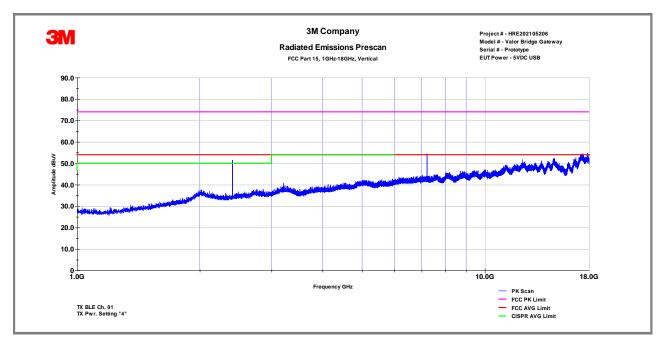
4.4	Radiated Emissions in restricted band						
Method:	EUT was rotated through the highest emission relative to the limit was used in making performed with external preand adjusting the receive a	easurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4 standards. UT was rotated through three orthogonal axes to determine which attitude (orientation) and arrangement produces the ghest emission relative to the limit; the attitude and device arrangement that produces the highest emission relative to be limit was used in making final radiated emission measurements. Spurious Radiated emissions measurements ware sufformed 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 attenna polarity, where applicable.					
		Laborato	ry Ambient Tempe	rature:		23°C	;
Test	Verification: ⊠		Relative Hu	midity:		55%	ı
			Atmospheric Pre	ssure:		1011 ml	oars
	Reference Standard(s):		020, Section 11.12			Measurement	Distance
			05/15.209/RSS Ger	า (ช.9)	☑ 3 Meters □		
	Frequency Range:	☑ 30 MHz to 1 GHz ☑ 1 GHz to 25 GHz					
	Nominal Voltage:	☐ 120VAC ⊠ 5VDC					
	Test Personnel:	Keith Schwartz KS			Date: 08/24/2021		
		Limits –15	.209 and RSS Ger	n			
Ero	equency (MHz)	Limit dB (μV/m)					
116	equency (IVII IZ)	Quasi-Peak	Average	Pe	eak	Distance	Results
	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	pass
	88 to 216	43.5				3	pass
	216 to 960	46				3	pass
	Above 960		54	7	74	3	pass

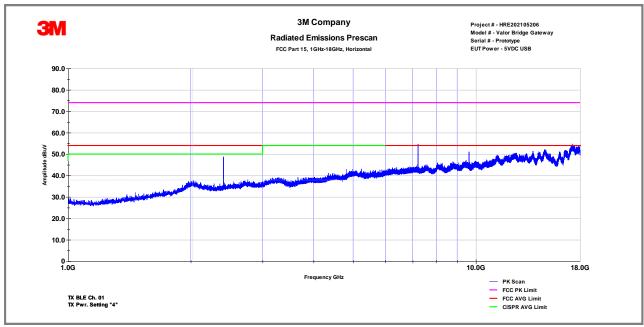
Modifications:	
	The lower limit applies at the transition frequency. An inverse proportionality factor of 20 dB per decade has been used to normalize the measured data to the specified distance for determining compliance
Notes	For emission in the restricted bands, the limit of 15.209 was used.
Note: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



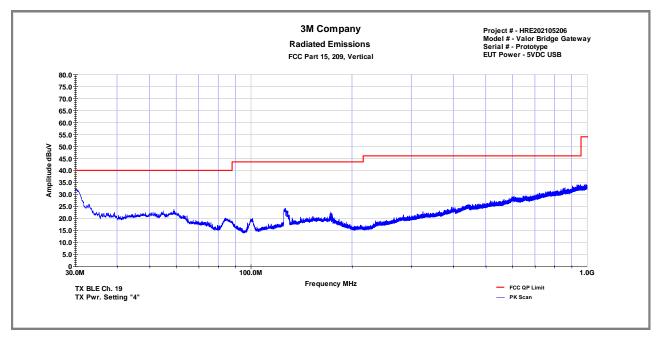


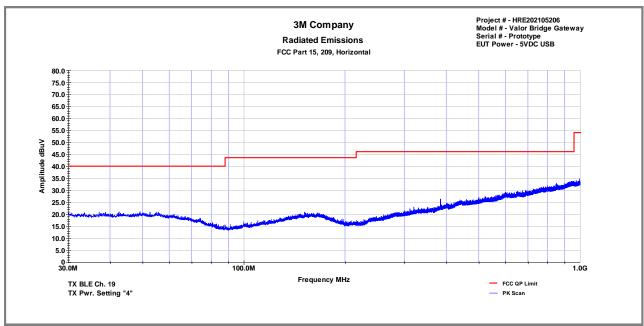
FCC Part 15.209 Radiated Emissions in restricted band - Low Channel



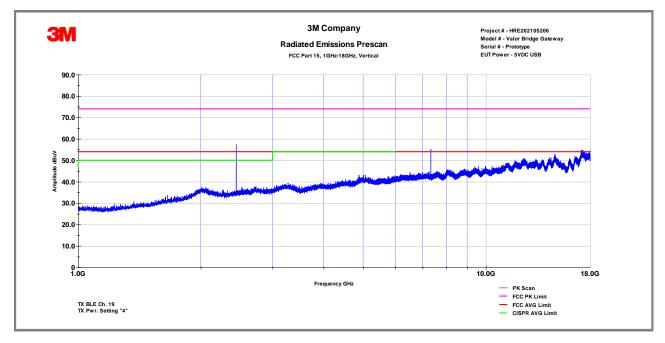


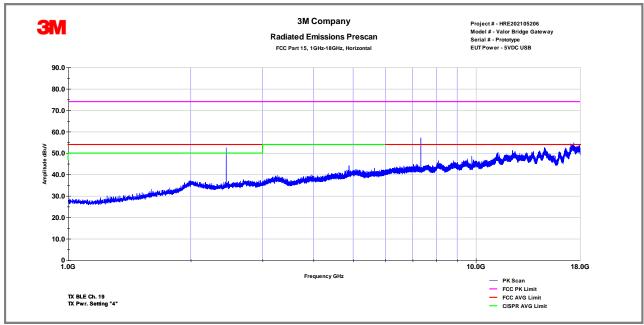
FCC Part 15.209 Radiated Emissions in restricted band – Low Channel



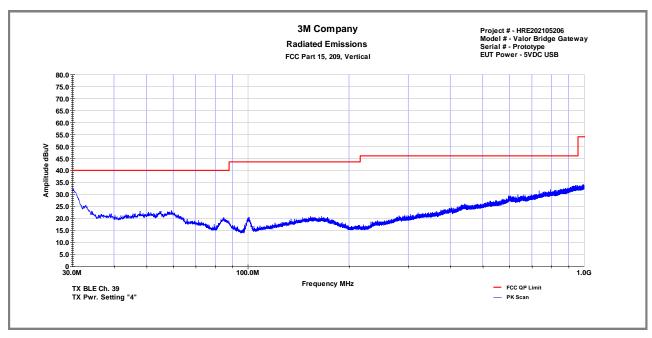


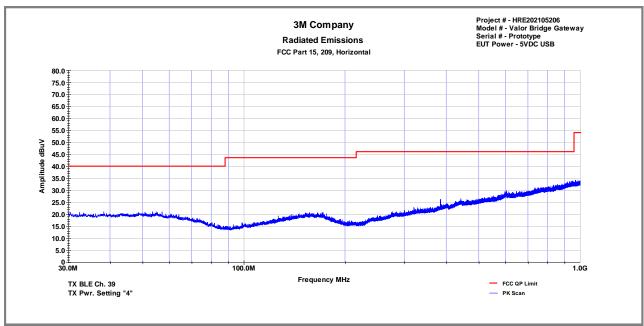
FCC Part 15.209 Radiated Emissions in restricted band - Mid Channel



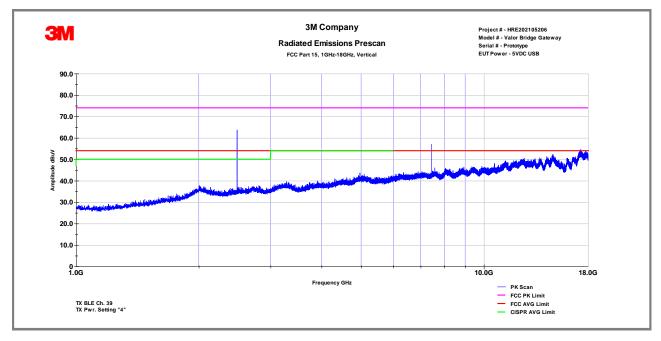


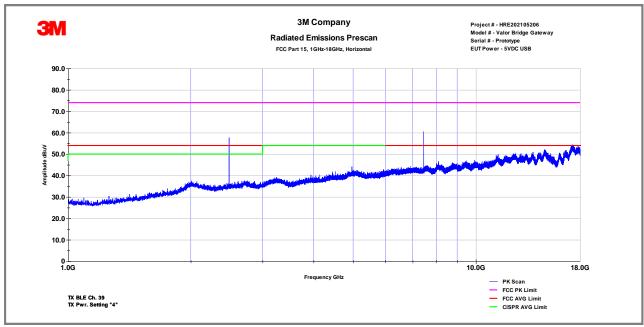
FCC Part 15.209 Radiated Emissions in restricted band - Mid Channel





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

3M EMC Laboratory

Pol	Frequency (MHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit	AVE Limit dBμV/m	PK Margin dB	AVG Margin dB
V	4804.00	49.96	41.2	-6.22	43.74	35.00	74.00	54.00	-30.26	-19.00
Н	4804.00	51.81	45.4	-6.22	45.59	39.17	74.00	54.00	-28.41	-14.83
V	9608.00	50.69	42.66	-1.60	49.09	41.06	74.00	54.00	-24.91	-12.94
Н	9608.00	54.68	47.67	-1.60	53.08	46.07	74.00	54.00	-20.92	-7.93
V	12010.00	46.87	35.63	3.51	50.38	39.14	74.00	54.00	-23.62	-14.86
Н	12010.00	46.71	35.66	3.51	50.22	39.17	74.00	54.00	-23.78	-14.83
	Net Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB)) Notes: Notes: Low Channel									

Pol	Frequency (MHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBμV/m	PK Limit	AVE Limit	PK Margin dB	AVG Margin dB
V	4880.00	52.53	44.0	-5.30	47.23	38.66	74.00	54.00	-26.77	-15.34
Н	4880.00	51.71	44.4	-5.30	46.41	39.13	74.00	54.00	-27.59	-14.87
V	7320.00	55.43	49.6	-3.60	51.83	46.00	74.00	54.00	-22.17	-8.00
Н	7320.00	60.72	48.5	-3.60	57.12	44.90	74.00	54.00	-16.88	-9.10
V	12200.00	47.06	35.5	3.27	50.33	38.79	74.00	54.00	-23.67	-15.21
Н	12200.00	47.06	35.5	3.27	50.33	38.79	74.00	54.00	-23.67	-15.21
	Net Reading (dBuV) = Reading (dBuV) + (Antenna with amp CF(dB)+Cable CF(dB)) Notes: Notes:									
		Mid Chann	el							

Pol	Frequency (MHz)	Peak dBµV/m	ΑVG dBμV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit dBµV/m	AVE Limit	PK Margin dB	AVG Margin dB
V	2700.00	46.87	35.63	-12.00	34.87	23.63	74.00	54.00	-39.13	-30.37
Н	2700.00	46.71	35.66	-12.00	34.71	23.66	74.00	54.00	-39.29	-30.34
V	4959.86	51.54	44.4	-5.01	46.53	39.39	74.00	54.00	-27.47	-14.61
Н	4959.86	50.45	42.9	-5.01	45.44	37.93	74.00	54.00	-28.56	-16.07
V	7439.40	63.50	51.0	-2.90	60.60	48.10	74.00	54.00	-13.40	-5.90
Н	7439.40	65.30	52.6	-2.90	62.40	49.70	74.00	54.00	-11.60	-4.30
V	12240.00	46.82	35.6	3.59	50.41	39.15	74.00	54.00	-23.59	-14.85
Н	12240.00	46.77	35.26	3.59	50.36	38.85	74.00	54.00	-23.64	-15.15
	Notes: Net AVG VBW>1/T=2KHz Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB)) AVG VBW>1/T=2KHz High Channel							F(dB))		



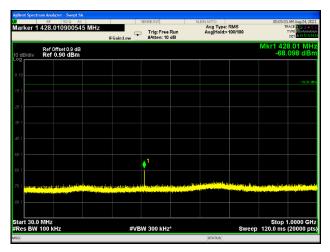
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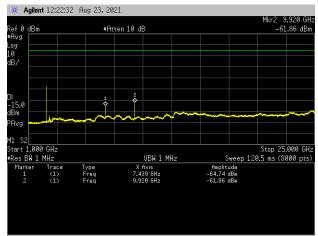
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4.5	Radiated Emiss	ted Emissions in non-restricted band						
Method:	The measurements were made with transmitter set to transmit continuously low, medium and high channels.							
		Laboratory Ambient Temperature:	23°C					
		Relative Humidity:	48%					
		Atmospheric Pressure:	1011 mbars					
Reference Standard(s):		⊠ KDB 558074	Measurement Point ☑ Conducted ☐ Radiated					
Fre	equency Range:	☑ 2402.0-2480.0 MHz						
li	n-band power in 100KHz:	⊠ 5.2dBm	Results:					
	Limit:	□ -24.8dBm (30dBc below in-band power)	>50dBc					
N	lominal Voltage:	☐ 120VAC ☐ 5VDC						
	Test Personnel:	Yuriy Litvinov Yuriy divinos	Date: 08/23/2021					
	•							

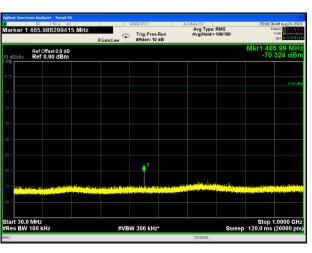
Note:	

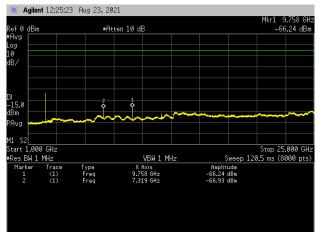




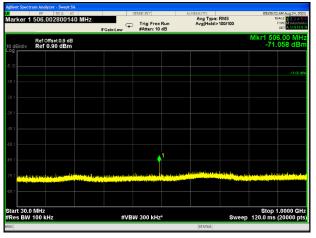


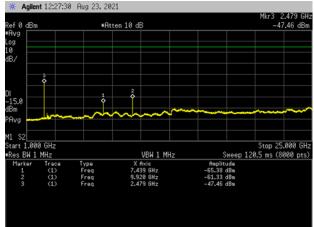
Conducted Spurious - Low Channel





Conducted Spurious - Mid Channel





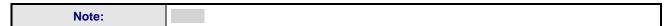
Conducted Spurious - High Channel

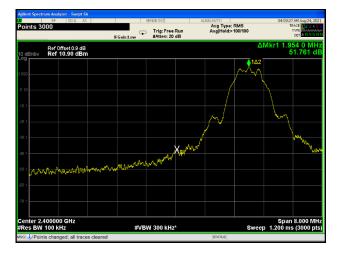


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4.6	Band-Edge Co	ge Compliance						
Method:	The measureme channels.	measurements were made with transmitter set to transmit continuously with modulated signal at low and nels.						
		Laboratory Ambient Temperature:	23°C					
		Relative Humidity:	48%					
		Atmospheric Pressure:	1011 mbars					
Referenc	ee Standard(s):	☐ ANSI C63.10:2020, Section 11.13.2☐ FCC Part 15.247/RSS 247☐ KDB 558074	Measurement Point ☑ Conducted ☐ Radiated					
Fred	quency Range:	⊠ 2402.0-2480.0 MHz	Results					
	Limit:	⊠ >30dBc	Low Ch., 2402 MHz > 51dBc High Ch., 2480 MHz > 63 dBc					
No	minal Voltage:	☐ 120VAC 🖾 5VDC						
Test Personnel:		Yuriy Litvinov ywy dwinn	Date: 08/23/2021					





Band Edge - Low Channel Center Freq. 2.400GHz



Band Edge - High Channel Center Freq. 2.4835GHz



Modifications:
Note:

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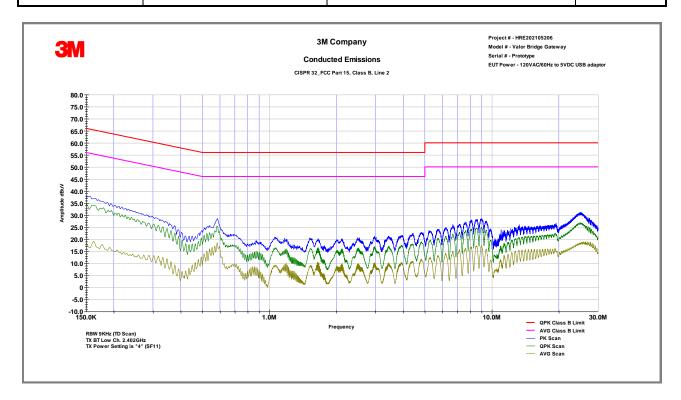
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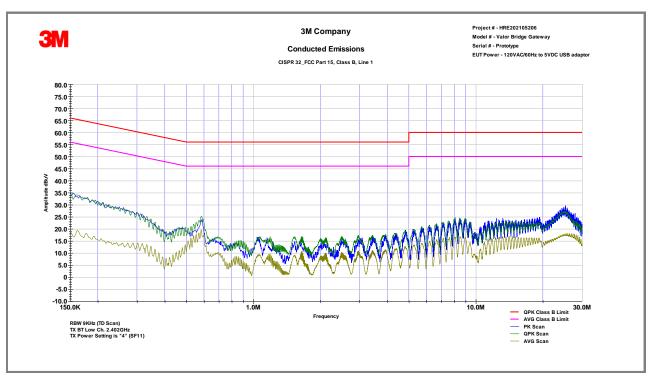
4.7	Conducted Emissions Data								
Method:	The AMN was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the AMN. 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.								
			Laboratory Ambient	Temperature:	23°C				
Test Verification: ⊠			Relative Humidity:		48%				
			Atmosph	eric Pressure:	1011 mbars				
Reference Standard(s):			☐ RSS GEN/FCC 15.207☐ ANSI C63.4:2014☐ ANSI C63.10:2020		Measurement Point ☑ Mains ☐ Telecommunication ports ☐				
		Nominal Voltage:							
		Test Personnel:	Keith Schwartz KS	Date: 08/18/2	8/2021				
Limits – Part 15.207/RSS Gen – AC Mains									
Eroguen	ov (MHz)	Limit dB (μV)							
Frequen	cy (MHz)	Quasi-Peak	Average	Result	Comments				
0.15 to	o 0.50	66 to 56	56 to 46	pass	Time Domain Scan				
0.50	to 5	56	46	pass	Time Domain Scan				
5 to	30	60	50	pass	Time Domain Scan				
			·						

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5.0	Test Equipment								
Test Equipment Used									
Description	Manufacturer	Model	Identifier	Last Cal. Date	Check				
Biconilog Antenna	Schwarzbeck	VULB 9168	9168-1070	10/20/2020	\boxtimes				
Horn Antenna	A.H. Systems	SAS 571	1010	10/20/2020					
Loop Antenna	A.H. Systems	EHA-51B	1213E	10/20/2020					
EMI Receiver	Rohde & Schwarz	ESW26	101412	10/20/2020					
Signal Analyzer	Agilent	N9000A	MY53031040	10/20/2020					
EMI Receiver	Agilent	E4448A	1530975	10/20/2020					
LISN	TESEQ	NNB51	1130	10/20/2020					
Coaxial Cable	Insulated Wire	2803	CBL2039	10/20/2020					
EMC Software	ETS-Lindgren	TILE 7		N/A	\boxtimes				
Equipment C	alibration Interval:			24 months					

6.0	Report revision history						
Revision Level		Date	Report Number	Notes			
0		03/25/2024	HRE202105206-1	Original Issue			