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APPLICANT:

HIGHER GROUND LLC

Electromagnetic Compatibility Test Report

Applicable Requirements: FCC CFR Title 47 Part 25 – Satellite Communications

Equipment Under Test: Model Number: Serial Number: Prepared for:

Satellite Texting Device SatPag N/S Higher Ground LLC 2225 East Bayshore Road, Suite 200 Palo Alto, CA 94303 - 3220

Tested by:

Bob Cole

Prepared by:

Amy Jones

Verified and Approved by:

Authorized Signatory

Bob Cole

Bob Cole

omyjones R. Cle

EMCE Engineering, Inc. 1726 Ringwood Ave. San Jose, CA 95131 USA



ACCREDITED BY THE NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM FOR THE SPECIFIC SCOPE OF ACCREDITATION UNDER TESTING LAB CODE #: 200092-0

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Test Report Revision History

Report Format	Report Version	Description	Issue Date
EMCE-TRF-FCC_TNB_25	1.0	Original Release	6-25-2017
EMCE-TRF-FCC_TNB_25	1.1	Content Revisions per TCB Review	9-13-17



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ADMINISTRATIVE INFORMATION

Test Laboratory:	EMCE Engineering	
	1726 Ringwood Ave.	
	San Jose, CA 95131 USA	
Facility No. registered	510-490-4307	
through NVLAP:	NVLAP Lab Code: 200092-0	
Test Site:	FCC : US0125	
Applicant Company Name :	Higher Ground LLC	
Applicant Contact Name :	Rob Reis	
Application Purpose :	Original	
EUT Description :	Satellite Texting Device	
Product Name :	SatPaq	
Model Number :	SatPaq	
Serial Number :	N/S	
Applied Requirements :	FCC CFR Title 47 Part 25 – Satellite Communications	
Measurement Distance :	3 m up to 1 GHz, 3 m above 1 GHz	
Classification of EUT :	Licensed Non-Broadcast Station Transmitter (TNB)	
RF Operating Frequencies :	5928 - 6170 MHz	
Modulation :	DSS	
Modulation : Rated RF Output Power (Watts) :	DSS 1.0 [Antenna Conducted]	
Modulation : Rated RF Output Power (Watts) : Type of Equipment :	DSS 1.0 [Antenna Conducted] Satellite Texting Device	
Modulation : Rated RF Output Power (Watts) : Type of Equipment : Testing Configuration :	DSS 1.0 [Antenna Conducted] Satellite Texting Device The EUT model name SatPaq, was setup per applicable specifications during EMI testing.	
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Additional Items Provided

Spare Batteries	N/A
Battery Charging Device	N/A
External Power Supply or AC	N/A
Adapter	
Test Jig of Interface Box	N/A
RF Test Fixture (for integrated	N/A
Antennas)	
Host System	N/A
User Manual	reviewed
Technical Documentation	reviewed



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Accreditation

EMCE Engineering, has been placed on the Federal Communications Commission's list of recognized facilities for Parts 15 and 18 DoC approvals. Per the request of EMCE Engineering, the facility has been added to the list of those who perform Measurement Services for the public on a fee basis. This list is published periodically and is also available on the FCC Website. Additionally, EMCE Engineering has been accredited by the National Institute for Standards and Technology under the NVLAP program (Testing Lab Code 200092-0).

Disclaimer

EMCE Engineering, Inc., assumes no responsibility for the continuing validity of test data when the Equipment under Test is not under the continuous physical control of EMCE. The signature below attests to the fact that all measurements reported herein were performed by myself or were made under my supervision, and are correct to the best of my knowledge and belief as of the date specified. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Tests were conducted by qualified EMCE Engineering, Inc. personnel utilizing test equipment maintained in a "current" state of calibration with traceability to NIST.

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Modifications

There were no modifications installed by EMCE Engineering.

Any modifications installed previous to testing by the Manufacturer will be incorporated into each production model, sold or leased.



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Statement of Compliance

We, EMCE Engineering, declare under our sole responsibility that the product tested complies with the following listed standards:

Equipment Under Test:	
Model Number:	
Serial Number:	
Report Number:	
Test Date:	
Company:	
Street Address:	

Satellite Texting Device SatPaq N/S 4322-2 6-16-2017 - 9-7-2017 Higher Ground LLC 2225 E. Bayshore Rd, Suite 200 Palo Alto, California, 94303

This Statement of Compliance is based upon compliance of the product with the following FCC Rules:

FCC CFR Title 47 Part 25	Satellite Communications

Issued by Test Laboratory:

Testing Lab Code: 200092-0

EMCE Engineering 1726 Ringwood Ave San Jose, CA 95131 USA

Verified By:

R. Cole

Bob Cole Authorized Signatory





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Test Location

Test Facility

All EMC Testing was performed at:

EMCE Engineering, Inc. 1726 Ringwood Ave. San Jose, CA 95131 USA

Site Attenuation

The site attenuation for radiated measurements has been determined for this test site using the method described in ANSI C63.4 Paragraph 5.4.6 and sub paragraphs. The site attenuation is measured annually.

Input Power for EUT

Battery Powered – 3.7VDC Lithium-ion



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Accessory Equipment Precautions

Care was taken that accessory equipment or adjacent equipment did not produce unacceptable interference so as to contaminate the final test data. The EMI receiver and its associated computer, printer and plotter were located greater than 15 meters away from the EUT during testing and were powered from a separately filtered power source.

Ambient Interference

3 Meter Semi-Anechoic Chamber is scanned for ambient RF interference before final RF Testing.

Personnel

All testing was performed by EMCE Engineering personnel who are properly trained for the instruments and procedures used.

Use of Interference Measurement Equipment

All of the emission measurements and field strength measurements were performed utilizing various EMC measurement equipment. The Emissions Measurement Lab utilizes the following basic instruments:

- 1. Toshiba Satellite Laptop Computer
- 2. EMI Test v4.1 measurement software
- 3. Rohde & Schwarz FSV40 Spectrum Analyzer
- 4. HP 8477F Pre Amp
- 5. HP 8449B Pre Amp
- 6. Sunol Sciences JB-6 Hybrid Antenna
- 7. EMCO 3110 Horn Antenna



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Test results are recorded on tabular data sheets and show final corrected values compared to the specification limit. Sample calculations show how the antenna factors, cable losses, amplifier gain, etc. are combined in the automatic analyzer program to produce the final corrected values shown on the graphs and data sheets.

Calibration of Measuring Equipment

The EMI Receiver (spectrum analyzer) is calibrated by an ISO 17025 Accredited calibration laboratory on an annual basis. The laboratory provides certification accredited to ISO 17025. Antenna factors are measured on an annual basis by an ISO 17025 Accredited Antenna Calibration Facility. Cable losses as well as amplifier gains are swept at least every month to verify accurate values.

Equipment	Serial Number	Last Calibration Date	Calibration Due Date
	14400400	7/0/2016	7/0/2010
Omega-IBTHXBP	14490199	7/8/2016	7/8/2018
Schaffner-NSG435	5892	7/8/2016	7/8/2018
Fluke-87	64920001	6/28/2016	6/28/2018
Sunol Sciences-JB1	A061416	6/12/2017	6/12/2018
EMCO-3816-2	9809-1089	8/12/2016	8/12/2018
Rohde & Schwarz- FSV40	101424	6/20/2016	6/20/2018
Sunol Sciences-JB6	A042610	6/12/2017	6/12/2018
A. H. Systems-SAS- 571	236	6/13/2016	6/13/2018

Equipment Calibration Data



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MEASUREMENT UNCERTAINTY

Measurement Uncertainty Budget Conducted Emissions 150 kHz – 30 MHz Per CISPR 16-4-2

Input Quantity	Uncertainty of x ₁		U(Xi)	Ci	C₁ U(Xi)
	dB	Probability Distribution Function	dB		dB
Receiver Reading	+/• 0.1	K = 1	0.1	1	0.1
Attenuation: AMN – Receiver	+/• 0.1	K=2	0.05	1	0.05
AMN Voltage Division Factor	+/• 0.2	K=2	0.1	1	0.1
Receiver Corrections					
Sine Wave Voltage	+/• 1.0	K=2	0.5	1	0.5
Pulse Amplitude Response	+/• 1.5	Rectangular	0.87	1	0.87
Pulse Rep Rate Response	+/• 1.5	Rectangular	0.87	1	0.87
Noise Floor Proximity	+/• 0.0		0.0	1	0.0
Mismatch: AMN – Receiver	+/• 0.75	U•shaped	0.53	1	0.53
AMN Impedance	+/• 2.65	Triangular	1.08	1	1.08
Total Measurement uncertainty – Conducted Emissions 150 kHz – 30 MHz $2u_c(P) = 4.45 \text{ dB}$				4.45 dB	



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Measurement Uncertainty Budget Radiated Emissions @ 10 Meters

Input Quantity	Uncerta	ainty of x_i	U(x)	Ci	Ci U (Xi)
	dB	Probability Distribution Function	dB		dB
Receiver Reading	+/- 0.1	K = 1	0.1	1	0.1
Attenuation, Antenna - receiver	+/- 0.1	K=2	0.05	1	0.05
Antenna Factor	+/- 2.0	K=2	1.0	1	1.0
		Receiver C	Corrections		•
Sine Wave Voltage	+/- 1.0	K = 1	0.5	1	0.5
Pulse Amplitude Response	+/- 1.5	Rectangular	0.87	1	0.87
Pulse Rep Rate Response	+/- 1.5	Rectangular	0.87	1	0.87
Noise Floor Proximity	+/- 0.5	K=2	0.25	1	0.25
Mismatch Antenna – Receiver	+/- 0.9	U shaped	0.67	1	0.67
		Antenna C	orrections	•	
AF Freq Interpolation	+/- 0.3	Rectangular	0.17	1	0.17
AF Height Deviations	+/- 0.5	Rectangular	0.29	1	0.29
Balance	+/- 0.3	Rectangular	0.17	1	0.17
Site Corrections					
Site Imperfections	+/- 3.0	Rectangular	1.22	1	0.82
Separation distance	+/- 0.1	Rectangular	0.06	1	0.06
Table Height	+/- 0.1	K=2	0.05	1	0.05
Total Measurement Uncertainty - Radiated Emissions @ 10 Meters 5.87					5.87



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Sample Calculations

Conducted Spurious Emissions

Measurements are compared directly to the applicable limits. The calculation is a s follows:

$$R_r - S = M$$

Where:

.

 R_r = Measured value in dBm S = Specification Limit

M = Margin

Radiated Spurious Emissions

Receiver readings are compared directly to a converted specification limit (dB form), the conversion uses the effective radiated power limit specified in the standard to calculate the expected field strength in free space using the following formula:

Where:

E = √30*P*G / d

E = Field Strength in V/M P = Power in Watts G = Gain of antenna in dB

D = Distance in meters

The field strength limit is then converted to decibel form (dBuV/M) and the margin of a given peak is calculated as follows:

 $M = R_c - L_s$

 $P_s - S = M$

Where:

$$\label{eq:margin} \begin{split} M &= Margin \\ R_c &= Corrected \ Reading \ in \ dBuV/M \\ L_s &= Calculated \ Specification \ Limit \ in \ dBuV/M \end{split}$$

When substitution measurements are required (all signals with <6 dB margin relative to the Specification limit) the margin of the emission relative to the effective radiated power is calculated as follows:

Where:

 P_s = ERP determined from antenna substitution (dBm) S = Specification limit in dBm M = Margin



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PREPARATION OF EUT FOR TEST

Setup of EUT

Power to EUT:	Battery
Grounding of EUT:	N/A
Software:	Channel Master - provided by Higher Ground LLC.

No Support Equipment was used.

Support Equipment							
Description	Model Number	Serial Number	Manufacturer	Power Cable Description			
N/A	N/A	N/A	N/A	N/A			
	Cable Description						
From	То	Length (Meters)	Shielded (Y/N)	Ferrite Loaded (Y/N)			
N/A							



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ATTACHMENT 1

NVLAP ISO 17025:2005

Accreditation Certificate



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1.0 Certificate of Accreditation





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ATTACHMENT 2

FCC CFR Title 47 Part 25 Measurement Results



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FCC 47 CFR Part 25

FCC Part Section	Test Description	Test Limit		Test Condition	Test Result
2.1049	Occupied Bandwidth	N/A - For Informational P	Conducted	PASS	
2.1046(a), 25.204	RF Output Power	30 dBm Antenna Cond	Conducted	PASS	
2.1051, 25.202(f)	Unwanted Emission at Antenna Terminal	Frequency removed from channel center by: 0 to 50% 50 to 100 % 100 to 250 % Over 250 %	Conducted	PASS	
2.1055. 25.202(d)	Frequency Stability	+/- 10ppm	Conducted	PASS	
2.1053, 15.209(a)	Radiated Spurious Emission	-13 dBm	Radiated	PASS	
25.216	Protection of Aeronautical Radio Navigation Satellite Service	≥ 20 dBc (Peak)	Conducted	N/A	

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FCC CFR Title 47 Part 25 – Satellite Communications

Test Results

1. 99% Occupied Bandwidth Measurement

Test Limit

Not Required.

Test Result		
Modulation Mode	Frequency (MHz)	99% Bandwidth (MHz)
DSS	5928	3.4732
DSS	6040	3.4732
DSS	6170	3.4732

99% Bandwidth :





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Date: 26 JUN 2017 12:28:30





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2. <u>RF Output Power Measurement</u>

Test Limit

In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits except as provided for in paragraph (c) of this section: + 40 dBW in any 4 kHz band for $\theta \le 0^\circ + 40 + 3\theta$ dBW in any 4 kHz band for $0^\circ < \theta \le 5^\circ$ Where θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

Test Results

Modulation Mode	Power Meter Level Average Power (dBm)	Antenna Gain - matching loss (dBi)	E.I.R.P Measured (dBm)	E.I.R.P Limit (dBm)	Tolerance	Result
DSS	30.0	7.75	37.75	39	+/- 1.25	PASS

Note: E.I.R.P (dBm) = Average Power (dBm) + Antenna Gain (dBi). FCC 47 CFR Part25, Limit Clause 25.204 +40 dBW in any 4 kHz band for $\theta \le 0^{\circ}$ +40 + 30 dBW in any 4 kHz band for $0^{\circ} < \theta \le 5^{\circ}$ For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.



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3. Unwanted Emission at Antenna Terminal Measurement

Test Limit

FCC Part 25.202(f) Emissions Limitations The mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule: (1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50% up to and including 100% of the authorized bandwidth: 25 decibels; (2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth: 35 decibels; (3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250% of the authorized bandwidth: an amount equal to 43 decibels plus 10 times Logarithm (to the base 10) of the transmitter power in watts

Note 1: The Resolution Bandwidth (RBW) was corrected from 4 kHz by 10log10 [(used RBW) / 4kHz] = 10log10 (3kHz / 4kHz) = -1.25; Note 2: Emission limits are computed based on following: 1. Emissions Limits (dBm) (50% -100% of Bandwidth) = P - 25 + CF = -6.67dBm; 2. Emissions Limits (dBm) (100% - 250% of Bandwidth) = P - 35 + CF = -16.67dBm; 3. Emissions Limits (dBm) (> 250% of Bandwidth) = P - [43 + 10 log10 PW] + 30 + CF = -14.25dBm; Where P = Measured mean power in dBm = 19.58 dBm PW = Measured mean power in W CF = RBW correction factor = -1.25



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5928 MHz



Date:16.JUN.2017 12:29:35

6049 MHz



Date:16.JUN.2017 12:22:19



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6170 MHz



Date: 16.JUN.2017 12:21:13

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4. Frequency Stability Under Temperature & Voltage Variations

Test Limit

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

 $Limit < \pm 10$ ppm

Test Result

Operating Frequency	5928.000 MHz
Reference Voltage	3.7 VDC
Deviation Limit	±10ppm

Voltage (%)	Power (VDC)	TEMP (C)		Frequency Freq. Dev. (MHz) (Hz)		Deviation (ppm)
100%	3.7	+25(Ref)		5.927999130	-870	-0.1467
100%	-30		5.9	27999860	-140	-0.0236
100%	-20		5.927999710		-290	-0.0489
100%	-10		5.929999570		-430	-0.0725
100%	0		5.9	27999957	- 43	-0.0072
100%	+10		5.9	27999130	-870	-0.1467
100%	+20		5.9	27999458	-542	-0.0914
100%	+30		5.927999870		-130	-0.0219
100%	+40		5.927999870		-130	-0.0219
100%	+50		5.927999884		-116	-0.0195
115% /4.25	+25 Ambient		5.927999510		-490	-0.0826
BAT.ENDPOINT 3.6	+25 Ambient		5.927999385		-615	-0.1037

Note: Deviation (ppm) = Frequency Deviation / Operating Frequency *106



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5. Radiated Spurious Emission Measurement

Test Limit

FCC Part 15.202(f)(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

Test Results

Test Lo	ocation:	EMCE Engineering •44366 S. Grimmer Blvd • Fremont, CA 94538 •										
Custon Specifi Work (Test Ty Equipr Manuf Model S/N:	ner: cation: Order #: ype: nent: acturer:	Higher Gr fCC 25.292 4308 Radiated S Satellite M Higher Gro SatPaq N/A	ound 2f RSE Li ccan essaging und LLC	mit Device		Date: 6/28/2017 Time: 09.16.32 AM Sequence#: 1 Tested By: Bob Cole						
Test E	Equipment:	C /NI		C	1.1	Dete	CID	Dete	A			
Functio	on	5/IN		La	libration	Date	Cal Due	e Date	Ass	set #		
Equip	ment Under	r Test (* = 1)	EUT):									
Functio	on .	N	lanufactu	rer	7	Model #			S/N			
Satellit	e Messaging	g F	ligher Gro	ound LLC		SatPaq			N/A			
Device												
Suppo	ort Devices:								C D I			
Function	on	Ν	Ianufactu	rer		Model #			S/N			
Test C	Conditions /	Notes:										
Part 25	Frequencie	s 5928 / 604	49 / 6170) tested	in 3 orth	agonal p	ositions.					
Worst	Casa data ra	norted										
worst												
Trans	ducer Leger	<u>nd:</u>				T O 0511						
T1=84	47 Pre-Amp	Asset $3/7$	(10			T2=25 I	LMR #001					
13=Su	noi IGHZ JI	36 S/N A42	610			14=aBu	V/M - dBm	i conve	ersion - 3M			
EXU	Alln: U UB	D.	a din a lia	ad have made	nain		Test I	Vistor	a. 2 Matara			
wieusu #	Frod	Ddna			ugiii. та	Т4	Diet	Corr	Space	Morgin	Dolor	
π	MHz	dBuV	dB	dB	dB	dB	Table (dRm	dBm	dR	Ant	
1	2914 447N	1 310	+0.0	+1.6	+0.0	+95.3	+0.0	-62.7	-13.0	-49 7	Vert	
1	Ave	. 51.0	10.0	11.0	10.0	190.0	8	02.7	6170 Xmit	17.7	185	
2	1926.958M	I 31.2	+0.0	+1.3	+0.0	+95.3	+0.0	-62.8	-13.0	-49.8	Vert	
	Ave								6049 Xmit		275	
3	3382.334M	1 30.0	+0.0	+1.9	+0.0	+95.3	+0.0	-63.4	-13.0	-50.4	Horiz	
	Ave						351		5928 Xmit		225	
4	714.925M	31.1	+27.1	+0.7	+20.4	+95.3	+0.0	-70.2	-13.0	-57.2	Vert	
	QP						122		6170 Xmit		171	

	FCC ID: 2AMUHSP001					Report # 43 9-7-2017					
EMC Compliance Testing	A	PPLICAN	NT:	Н	HIGHER GROUND LLC				Page 27 of 29		
5 336.122M	33.1	+27.0	+0.2	+14.1	+95.3	+0.0	-74.9	-13.0	-61.9	Horiz	
OP						5		5928 Xmit		125	

EMCE Engineering Date: 6/28/2017 Time: 09.16.32 AM Higher Ground WO#: 4308 fCC 25.292f RSE Limit Test Distance: 3 Meters Sequence#: 1 Ext ATTN: 0 dB





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6. Protection of Aeronautical Radio Navigation Satellite Service

Test Limit

FCC Part 25.216(h)(j)(f) (h) Mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03-283 with assigned uplink frequencies in the 1626.5-1660.5 MHz band shall suppress the power density of emissions in the 1605-1610 MHz bandsegment to an extent determined by linear interpolation from -70 dBW/MHz at 1605 MHz to -46 dBW/MHz at 1610 MHz, averaged over any 2 millisecond active transmission interval. The e.i.r.p of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from -80 dBW at 1605 MHz to -56 dBW at 1610 MHz, averaged over any 2 millisecond active transmission interval. (i) The e.i.r.p density of carrier-off state emissions from mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03-283 with assigned uplink frequencies between 1 and 3 GHz shall not exceed -80 dBW/MHz in the 1559-1610 MHz band averaged over any two millisecond interval. (i) A Root-Mean-Square detector shall be used for all power density measurements. FCC Part 25.254(b)(4) Special requirements for ancillary terrestrial components operating in the 1610-1626.5 MHz / 2483.5-2500 MHz bands (b) An applicant for an ancillary terrestrial component in these bands must demonstrate that mobile terminals shall: (4) ATC mobile terminals operating in assigned frequencies in the 1610-1626.5 MHz band shall not generate EIRP density, averaged over any two-millisecond active transmission interval, greater than -70 dBW/MHz in the 1559-1605 MHz band or greater than a level determined by linear interpolation in the 1605-1610 MHz band, from -70 dBW/MHz at 1605 MHz to -10 dBW/MHz at 1610 MHz. The EIRP, averaged over any two-millisecond active transmission interval, of discrete out-of-band emissions of less than 700 Hz bandwidth from such mobile terminals shall not exceed -80 dBW in the 1559-1605 MHz band or exceed a level determined by linear interpolation in the 1605-1610 MHz band, from -80 dBW at 1605 MHz to -20 dBW at 1610 MHz. The EIRP density of carrier-off-state emissions from such mobile terminals shall not exceed -80 dBW/MHz in the 1559-1610 MHz band, averaged over a two-millisecond interval. A root-mean-square detector function with a resolution bandwidth of one megahertz or equivalent and no less video bandwidth shall be used to measure wideband EIRP density for purposes of this rule, and narrowband EIRP shall be measured with a root-mean-square detector function with a resolution bandwidth of one kilohertz or equivalent.

Test Result N/A

CONCLUSION

The data collected relates only to the item(s) tested, and shows that the Higher Ground LLC **SatPaq** device is in compliance with Part 25 of the FCC Rules.



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END OF REPORT