Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
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	)	
Application of KVH Industries, Inc. for License to Operate a Network of Vehicle-Mounted Earth Stations ("VMESs") in the 14.0-14.5 GHz (Transmit) and 10.95–11.2 GHz, 11.45–11.7 GHz and 11.7-12.2 GHz (Receive) Frequency Bands	)	File No. _____
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APPLICATION FOR VMES NETWORK LICENSE

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SUMMARY

KVH Industries, Inc. ("KVH") hereby submits this application for a vehicle-mounted earth station ("VMES") network license to operate up to 250 Ku-band TracPhone V7 Land and TracPhone V3 Land terminals (125 of each type) in the land mobile context throughout the United States. The land-based terminals will operate with ALSAT (and specifically the AMC-15, AMC-21 and GE-23 satellites) in the 14.0-14.5 GHz (transmit) and 11.7-12.2 GHz (receive) bands, as well as with GE-23 in the 10.95-11.2 and 11.45-11.7 receive bands. Network operations will be controlled by KVH from its headquarters via a single network operations center located in Carlsbad, California.

The V7 terminal employs a 0.6m antenna and is authorized by the Commission to operate in the maritime context as a Ku-band earth station onboard vessel ("ESV"). In addition, KVH received a special temporary authorization ("STA") to operate the V7 in the land mobile context and has confirmed that the V7 is appropriate for use as a VMES terminal. As demonstrated herein, the V7 terminal complies fully with the Commission's VMES rules and policies, including off-axis EIRP spectral density limits and other provisions designed to protect co-frequency operations from harmful interference. The V3 terminal employs a 0.37m antenna, similarly complies with the Commission's rules and policies and is also authorized by the Commission to operate in the maritime context as a Ku-band ESV.

The KVH terminals are highly efficient and affordable, and grant of KVH's application for a VMES network license will serve the public interest by extending the reach of vehicular broadband communications to more first responders, newsgathering vehicles, public transportation (*e.g.*, trains), leisure travelers and other users throughout the United States.

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APPLICATION FOR VMES NETWORK LICENSE

KVH Industries, Inc. ("KVH"), by its attorneys and pursuant to Section 25.226 of the Commission's rules, 47 C.F.R. § 25.226, hereby submits this application to operate a network of 250 V7 and V3 Ku-band miniVSAT terminals as Vehicle-Mounted Earth Stations ("VMESs") communicating with ALSAT (and specifically the AMC-15, AMC-21 and GE-23 satellites) in the 14.0-14.5 GHz (transmit) and 11.7-12.2 GHz (receive) bands, as well as with GE-23 in 10.95-11.2 and 11.45-11.7 receive bands. Network operations will be controlled by KVH from its headquarters via a single network operations center located in Carlsbad, California.

The TracPhone V7 Land and TracPhone V3 Land terminals have been previously authorized by the Commission to provide maritime broadband services as earth stations onboard vessels ("ESVs"). As demonstrated herein and in prior applications, and confirmed by operations in both the land mobile and maritime contexts, the V7 and V3 comply fully with the Commission's two-degree spacing requirements. Because the terminals will extend high-speed Internet access to first responder, satellite newsgathering vehicles, public transportation (*e.g.*, trains), leisure travelers and other mobile broadband users, grant of this application would strongly serve the public interest.

I. INTRODUCTION

The Commission has authorized KVH to operate the V7 terminals on a temporary basis for land mobile communications and on a long-term commercial basis as part of KVH's Ku-band ESV network. Such operations have resulted in no complaints of harmful interference. In this application, KVH requests long-term authority for V7 and similar V3 VMES operations, and demonstrates that the terminals comply with the Commission's VMES licensing rules.

KVH holds special temporary authorization to operate the V7 terminal in the land mobile satellite-service ("LMSS") to communicate with the AMC-15 satellite in the 14.0-14.5 GHz and 11.7-12.2 GHz frequency bands.[1] KVH has received no complaints of interference based on its operation of those terminals. In addition, KVH currently holds a Ku-band ESV network license to operate up to 3,500 V7 and 1,000 V3 terminals to communicate with ALSAT and GE-23 in extended Ku-band downlink frequencies.[2] These terminals have operated in the maritime context without any report of interference.

The Commission's ESV rules are virtually identical to its VMES rules with respect to protection of adjacent satellites and other co-frequency services from potential interference, and

[1] *See* IBFS File No. SES-STA-20091019-01338, Call Sign E030131 (granted Nov. 9, 2010). KVH filed its application for such authority before the Commission's new VMES rules were effective.

[2] *See* IBFS File No. SES-MOD-20110126-00062 (Call Sign E090001). KVH previously held three separate ESV network licenses for the V7 terminal to communicate with three specific satellite points of communication. Call Sign E060335 authorized KVH's ESV network to communicate with the AMC-21 satellite at 125º degrees W.L. using a hub earth station located in Miami, Florida. *See* IBFS File No. SES-LIC-20060824-01502. The separately licensed hub earth station's Call Sign is E040267. Call Sign E070085 authorized communication with the AMC-15 satellite at 105º W.L. using a hub earth station located in Carlsbad, California. *See* IBFS File No. SES-LIC-20070504-00563. The separately licensed hub earth station's Call Sign is E030131. Call Sign E090001 authorized KVH's ESVs to communicate with the GE-23 satellite at 172º E.L. using a hub earth station located in Kapolei, Hawaii. *See* IBFS File No. SES-LIC-20081104-01450. The separately licensed hub earth station's Call Sign is E010236.

KVH has established the V7's compliance with these requirements in multiple ESV applications and years of interference-free operation. KVH has also established the V3's compliance with these requirements in the recently granted ESV application. Moreover, the operational environment in the maritime context (including vessel pitch, yaw and roll as well as jarring effects of waves in various sea states) is significantly harsher than on land (with smooth road surfaces and truly stationary temporary fixed operations). Thus, the range of dynamic motion affecting antenna pointing is far easier to address in the land mobile context.

KVH has verified the ability of the V7 to operate on land pursuant to LMSS STA authority. This real-world operating experience, as well as the extensive technical demonstration included herein, confirm the V7 complies with the Commission's Ku-band VMES rules. The recently authorized V3 terminal will operate in much the same manner as the V7 and will also meet the Commission's Ku-band VMES rules.

II. THE V7 AND V3 TERMINALS SATISFY THE COMMISSION'S VMES REQUIREMENTS

As demonstrated below, the V7 and V3 terminals operate in compliance with the Commission's rules and policies governing Ku-band VMES operations.[3]

[3] KVH has included regulatory compliance matrices in Section 4 of the Technical Exhibits for the V7 and V3. In the context of preparing the cross-polarization spectral density tables required by the Commission's VMES rules, KVH discovered a minor, theoretical exceedance of the mask for the V7 terminal in a 1.1 degree range at 14.0 GHz (only) when the network operates at its maximum number of simultaneously-transmitting terminals (N=7 using an 18 MHz channel; other transmit frequencies do not show a similar exceedance). KVH does not believe a waiver of the VMES rules is necessary to address this theoretical exceedance, but identifies the issue out of an abundance of caution. To the extent the Commission concludes that a waiver may be necessary, KVH has requested a waiver of the Commission's rules with respect to the minor cross-polarization exceedance in Section II.E.1.b., *infra*.

A. Description of the V7 Terminal

The V7 terminal employs a 0.6m parabolic reflector with a rear-fed sub-reflector feed assembly design. The terminal will automatically search for and acquire the designated satellite and maintain precise pointing via automatic control of the azimuth, elevation and polarization angles. The V7's main lobe does not conform to the standards specified in Section 25.209(a) and (b). Accordingly, KVH will operate with spread spectrum modulation that will bring the off-axis EIRP spectral density of the terminal within the limits specified in Section 25.226 of the Commission's rules.

Figure 1: KVH V7 0.6m Ku-band VMES

The proposed VMES return link transmission (inbound) channel supports data rates of 32 kbit/s, 64 kbit/s, 128 kbit/s, 256 kbit/s, and 512 kbit/s. The VMES uplink transmission utilizes a spread spectrum modulation that will require channel bandwidths between 18 MHz and 36 MHz. The forward channel (outbound from the hub earth station to the VMES) will be between 3-10 Mbits/s aggregate with individual end user rates at 512 kbit/s - 2 Mbit/s. The forward channel is

also spread over the 18 MHz to 36 MHz channel and is overlaid onto the same transponder spectrum using a technique called PCMA.[4]

A summary of the V7 terminals operating characteristics are set forth in Tables 1 and 2, below. Additional information regarding the uplink transmission parameters for the 18 and 36 MHz bandwidth channels are included in the Technical Exhibit.[5]

Antenna diameter	0.6m
Type of Antenna	Parabolic rear-fed
Peak Power (SSPA)	4 watts
Transmit Bandwidths	18, 27, 36 MHz
Transmit Gain	36.8 dBi at 14 GHz
EIRP	42.4 dBW
Transmit Data Rate	32 kbps to 512 kbps
Transmit Polarization	Horizontal or Vertical
Transmit Max PSD	<10 dBW/4kHz
Transmit Azimuth, Elevation Beamwidth	2.36°
Receive G/T	13 dB/K minimum
Receive Bandwidth	500 MHz
Receive Polarization	Dual Vertical and Horizontal

Table 1. V7 Terminal Operating Parameters

[4] Paired Carrier Multiple Access ("PCMA") is a proprietary technique developed by ViaSat for its spread spectrum ArcLight service.

[5] *See* Technical Exhibit 1, Section 3.

Azimuth	Continuous coverage over full 360º
Elevation	10° to 80º antenna elevation
Position accuracy (AZ)	0.6º RMS in-motion accuracy (0.4º conscan plus 0.2º error); Declared Maximum Pointing Error: 1.0º
Dynamic Tracking capability	Roll: +/-25° at 8 second period Pitch: +/-15° at 5 second period Yaw: +/-8° at 50 second period Azimuth Turn rate: 12°/s and 15°/s^2 acceleration

Table 2. V7 Terminal Antenna Control Parameters

The target end users of this terminal are first responders, satellite newsgathering vehicles and other government and commercial mobile broadband users. The V7 terminal will provide high-speed connectivity for a range of communications applications such as e-mail, Internet access and voice services in the land mobile context.

B. Description of the V3 Terminal

The V3 terminal employs a 0.37m parabolic reflector with a rear-fed sub-reflector feed assembly design. The terminal will automatically search for and acquire the designated satellite and maintain precise pointing via automatic control of the azimuth, elevation and polarization angles. The associated RF equipment is integrated into the base of the terminal and includes a three watt (3W) block upconverter.

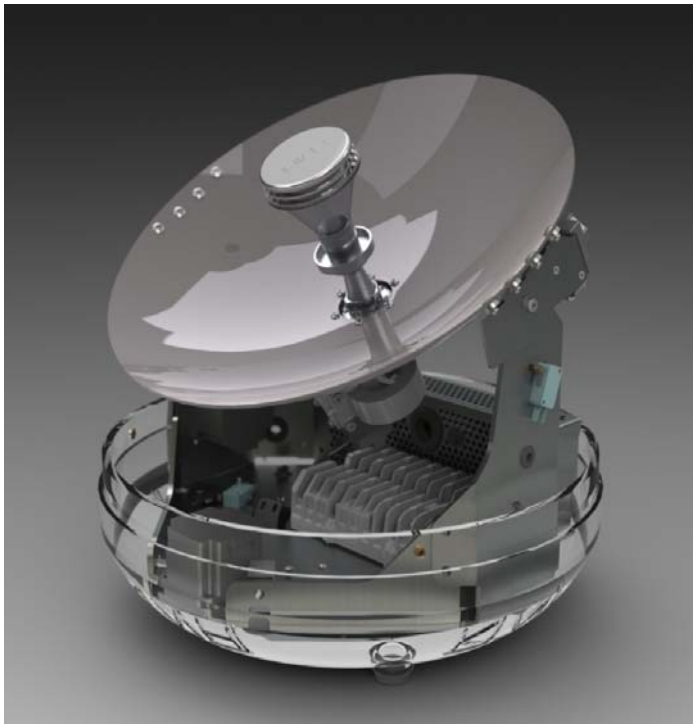

Figure 2: KVH V3 0.37m Ku-band Terminal

The proposed ESV uplink return transmission (inbound) channel supports data rates of 32 kbit/s, 64 kbit/s, 128 kbit/s, 256 kbit/s, and 512 kbit/s. The ESV uplink transmission utilizes a spread spectrum modulation that will require channel bandwidths of 18 MHz and 36 MHz. The forward channel (outbound from the hub earth station to the ESV) will be between 3-10 Mbits/s aggregate with individual end user rates at 0.5-2 Mbit/s. The forward channel is also spread over the 18 MHz or 36 MHz channel and is overlaid onto the same transponder spectrum using PCMA.

A summary of the V3 terminals operating characteristics are set forth in Tables 3 and 4, below.

Antenna diameter	0.37 m
Type of Antenna	Parabolic rear-fed
Peak Power (SSPA)	3 watts
Transmit Bandwidth	18, 36 MHz
Transmit Gain	33 dBi at 14 GHz
EIRP	38 dBW
Transmit Data Rate	32 kbps to 512 Mbps
Transmit Polarization	Horizontal or Vertical
Transmit Max PSD	<10 dBW/4kHz
Transmit Azimuth, Elevation Beamwidth	3.5° (symmetrical antenna)
Receive G/T	10 dB/K minimum
Receive Bandwidth	500 MHz
Receive Polarization	Dual Vertical and Horizontal

Table 3. V3 Terminal Operating Parameters

Azimuth	Continuous coverage over full 360º
Elevation	10 to 80º antenna elevation
Position accuracy (AZ)	Conscan 0.6º RMS; 0.8º RMS in-motion accuracy; Declared Maximum Pointing Error: 1.5º
Dynamic Tracking capability	Roll: +/-25° at 8 second period Pitch: +/-15° at 5 second period Yaw: +/-8° at 50 second period Azimuth Turn rate: 12°/s and 15°/s^2 acceleration

Table 4. V3 Terminal Antenna Control Parameters

C. Satellite Points of Communication, Hubs and Network Control Center

In the instant application, KVH requests authority to operate a network of up to 125 V7 and 125 V3 VMES terminals in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-

14.5 GHz bands.[6] KVH requests authority for its VMES terminals to communicate in the extended Ku-band receive frequencies (10.95-11.2 GHz and 11.45-11.7 GHz bands) only with the GE-23 satellite. The Commission authorized VMES receive operations in these bands in its VMES Order.[7] The terminals will communicate in conventional Ku-band frequencies with ALSAT (including specifically AMC-15, AMC-21 and the GE-23), previously authorized for V7 and V3 ESV operations. Like KVH's ESV network, the VMES network will be controlled by the network control center in Carlsbad, California.[8]

D. Emissions Designators

KVH's granted V7 LMSS authorization requested authority to operate the terminals over channel bandwidths of 14 MHz and 27 MHz.[9] The V7 ESV terminal was authorized to operate over channel bandwidths of 22 MHz (transmit) and 30 MHz (receive).[10] KVH seeks in the instant application to operate over the bandwidths of 18 MHz and 36 MHz. The requested emissions designators are as follows:

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[6] In the 10.95–11.2 GHz and 11.45–11.7 GHz frequency bands, KVH will not claim protection from interference from any authorized terrestrial stations to which frequencies are either already assigned, or may be assigned in the future. *See* 47 C.F.R. § 25.226(a)(7).

[7] *See Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service*, IB Docket No. 07-101, Report and Order, FCC 09-64, n.1 (2009) ("VMES Order"). *See also* 47 C.F.R. §§ 25.202(a)(10); 25.226(a).

[8] KVH maintains ultimate direction and control of its Ku-band VMES operations via a network management agreement with ViaSat, Inc.

[9] *See* IBFS File No. SES-STA-20091019-01338, Call Sign E030131, Exhibit A at 8. Only communications with the GE-23 satellite will use a 27 MHz bandwidth channel.

[10] *See* IBFS File No. SES-LIC-20081104-01450, Call Sign E090001. The authorized emissions designators were 22M0G7D and 30M0G7D.

Satellite(s)	Frequencies	Emissions Designators
ALSAT	11.7-12.2 Receive	18M0G7D, 36M0G7D
	14.0-14.5 Transmit	18M0G7D, 36M0G7D
GE-23 at 172° EL (additional designator and bands)	11.7-12.2 Receive	18M0G7D, 27M0G7D, 36M0G7D
	14.0-14.5 Transmit	18M0G7D, 27M0G7D, 36M0G7D
	10.95-11.2 Receive	27M0G7D
	11.45-11.7 Receive	27M0G7D

E. Compliance with the Ku-band VMES Rules

The V7 and V3 terminals comply with Commission rules and policies designed to protect other users of the Ku-band from harmful interference from VMES transmit operations.

1. Off-Axis EIRP Spectral Density Limits

The KVH VMES terminals will operate in accordance with the off-axis EIRP spectral density limits for Ku-band VMES terminals in the Commission's rules.[11]

a. The KVH VMES Antennas Comply with the VMES Off-Axis EIRP Spectral Density Limits

The KHV VMESs will transmit using CRMA spreading[12] over 18, 27 or 36 MHz channel bandwidths. The small diameter KVH antennas do not meet the Commission's Section 25.209 antenna pattern.[13] However, the aggregate EIRP levels of the terminals do not exceed the limits

[11] KVH notes a minor, theoretical exceedance of the cross-polarization limits in Section 25.226(a)(1)(i)(C) for the V7 when operating with the theoretical maximum number of simultaneously transmitting antennas at 14 GHz (only). The V7 terminal complies with co-polarization off-axis EIRP spectral density limits in both the azimuth and elevation plane. *See* Section II.E.1.b., *infra*.

[12] CRMA, or Code Reuse Multiple Access, is a ViaSat proprietary spread spectrum technique, similar to CDMA, used in the ArcLight satellite system.

[13] *See* V7 and V3 antenna gain plots in their respective Technical Exhibits, Section 6.

specified for Ku-band VMESs in Section 25.226 of the Commission's rules.[14] The co-polarized off-axis EIRP spectral density levels of the V7 are shown in Figures 3-6 below. Note that a calculated worst case aggregate EIRP occurs when N=14 users for the 36 MHz channel and when N=7 users for the 18 MHz channel. Figure 7 below shows the V7 worst case cross-pol off-axis EIRP density plots versus the VMES off axis EIRP spectral-density mask.

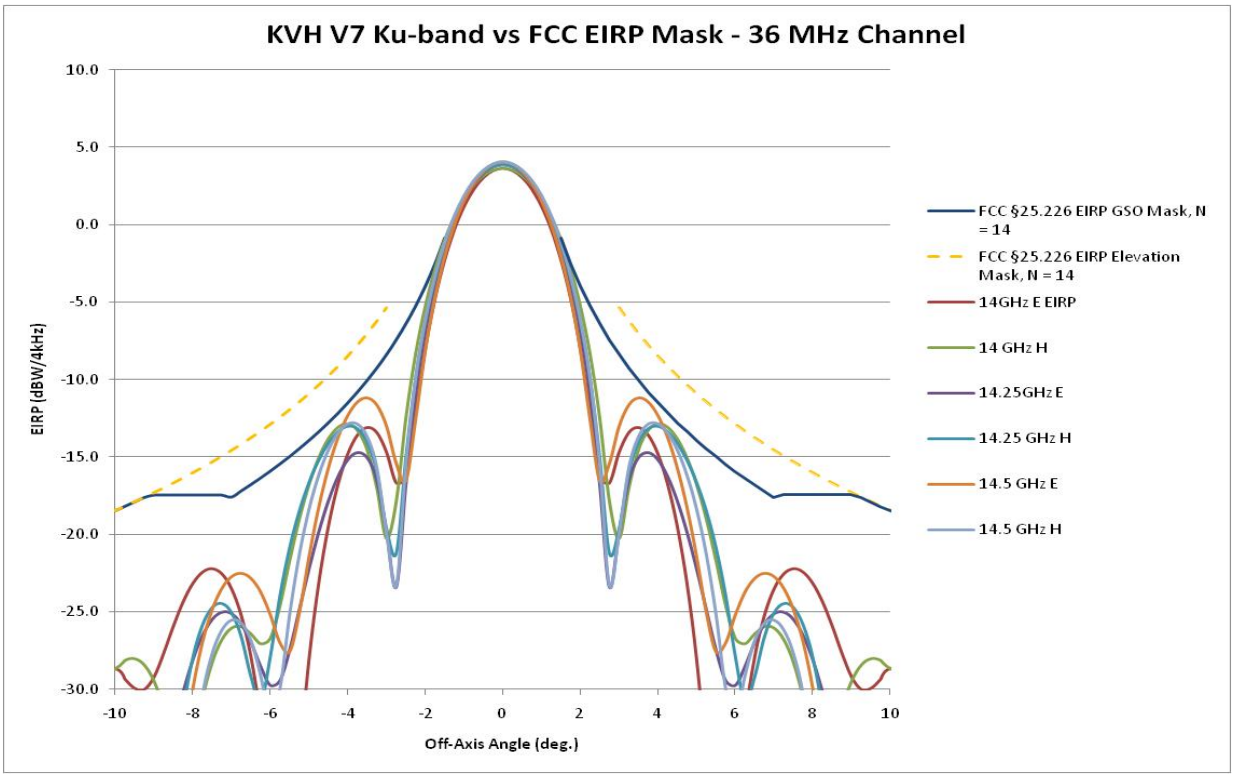

Figure 3 - V7 Off-Axis EIRP Spectral Density – 36 MHz Channel

[14] *See* 47 C.F.R. § 25.226(a)(1)(i).

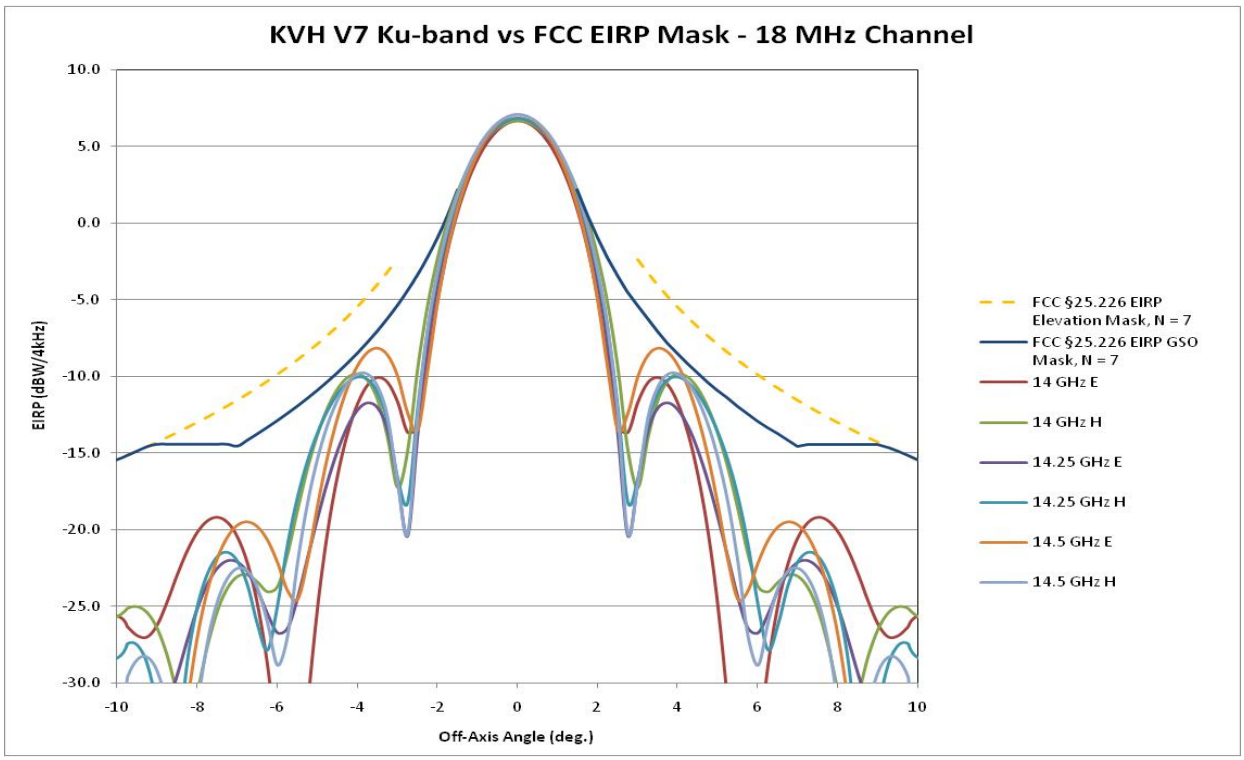

Figure 4 - V7 Off-Axis EIRP Spectral Density – 18 MHz Channel

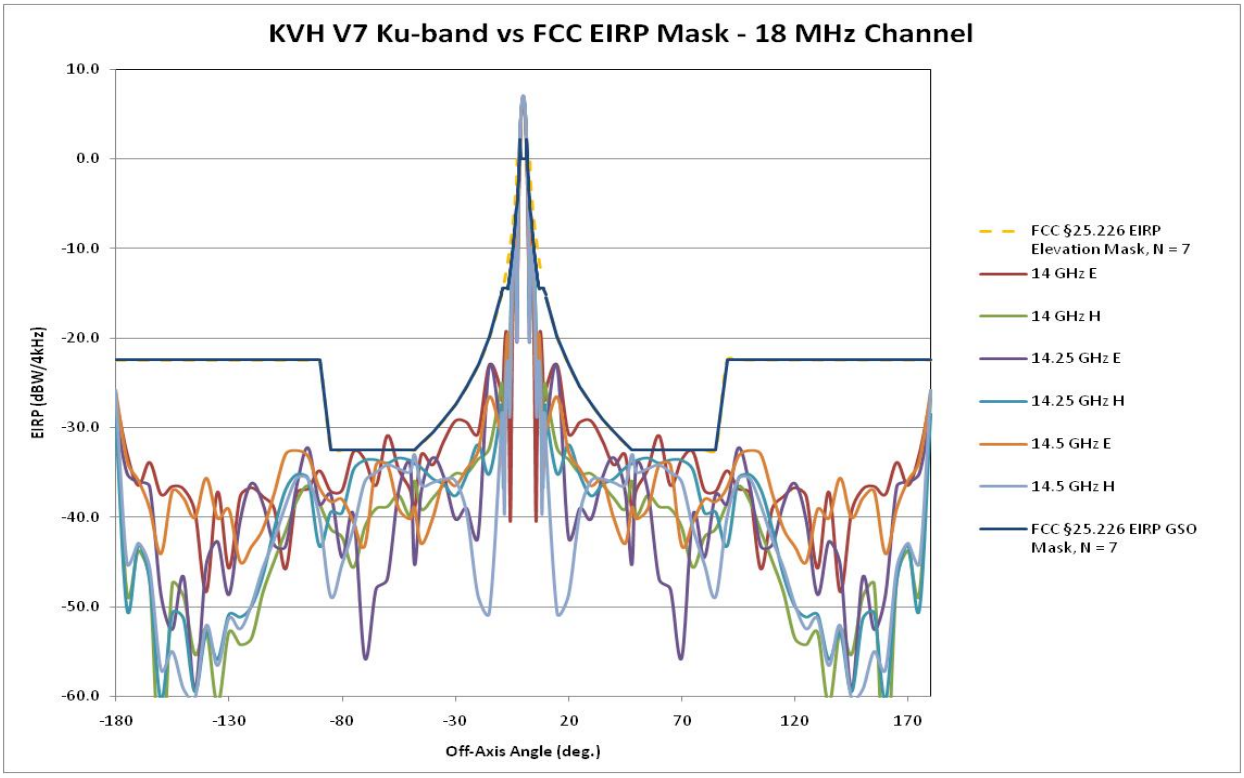

Figure 5 – 18 MHz Off-Axis EIRP Spectral Density

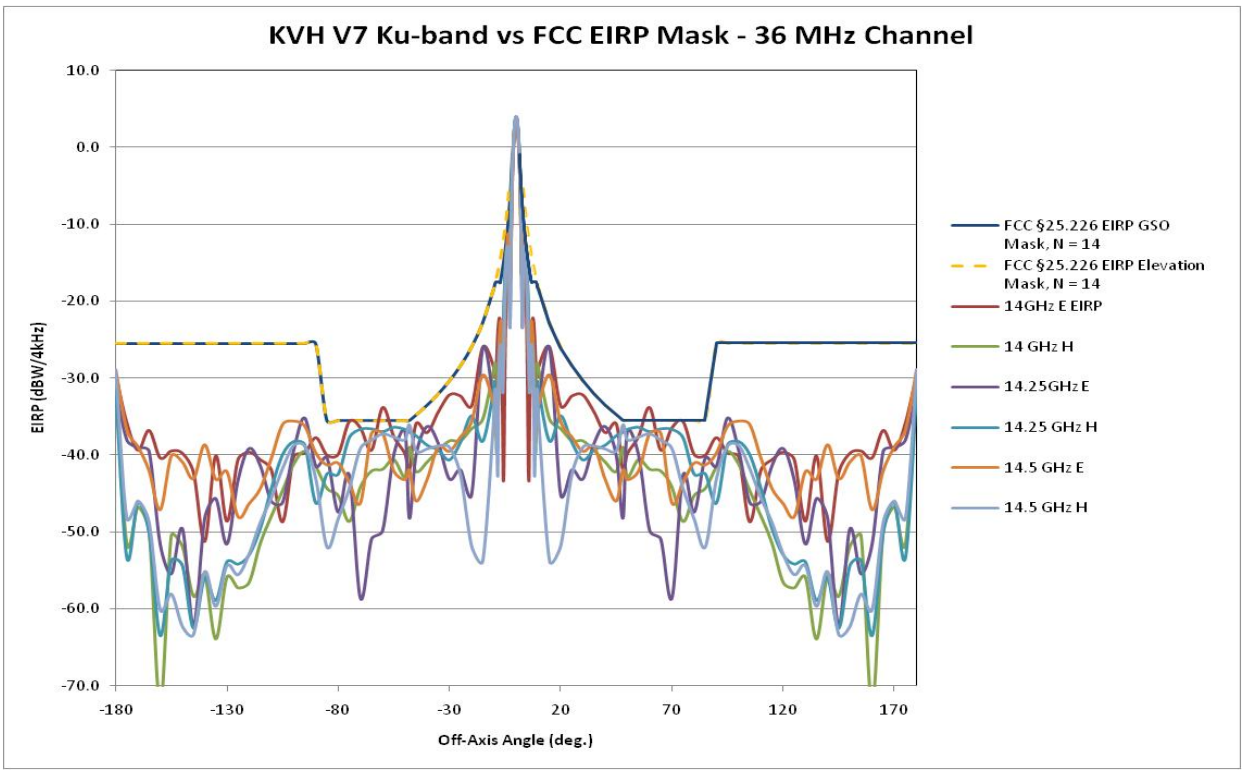

Figure 6 – 36 MHz Channel Off-Axis EIRP Spectral Density

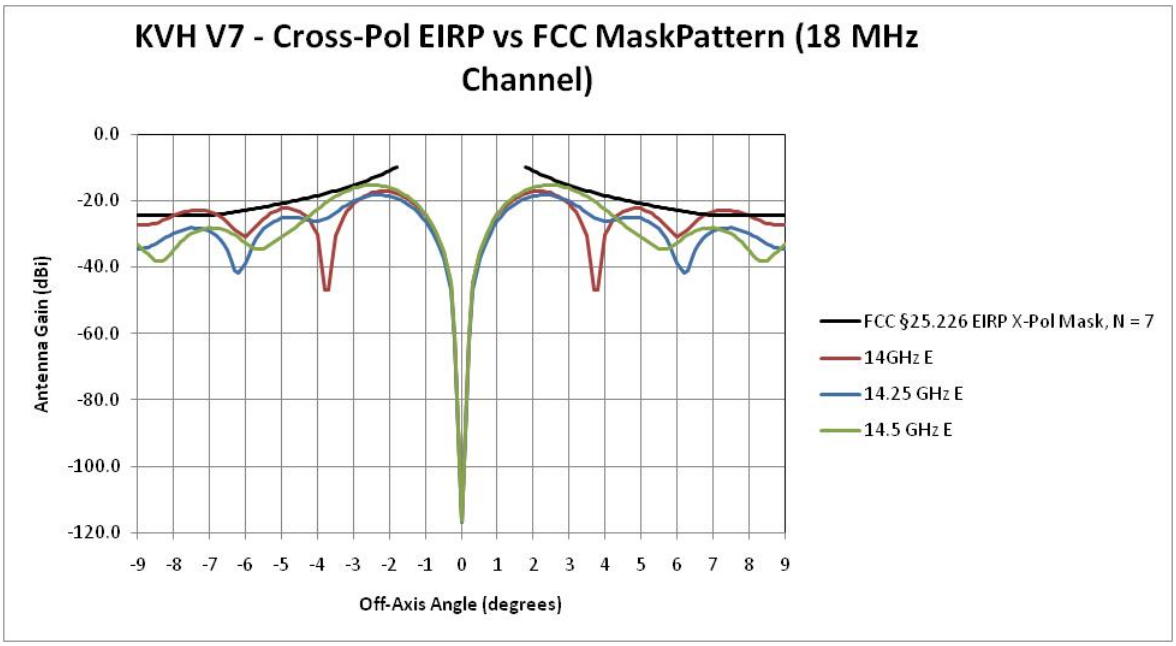

Figure 7 – 18 MHz Channel Cross-Pol Off-Axis EIRP Spectral Density

The co-polarized off-axis EIRP spectral density levels of the KVH VMES terminal are shown in Figures 8 through 11 below. Note that a calculated worst case aggregate EIRP occurs

when N=13 users for the 36 MHz channel and when N=6 users for the 18 MHz channel. Figure 12 below shows the V3 worst case cross-pol off-axis EIRP density plots versus the VMES spectral density mask.

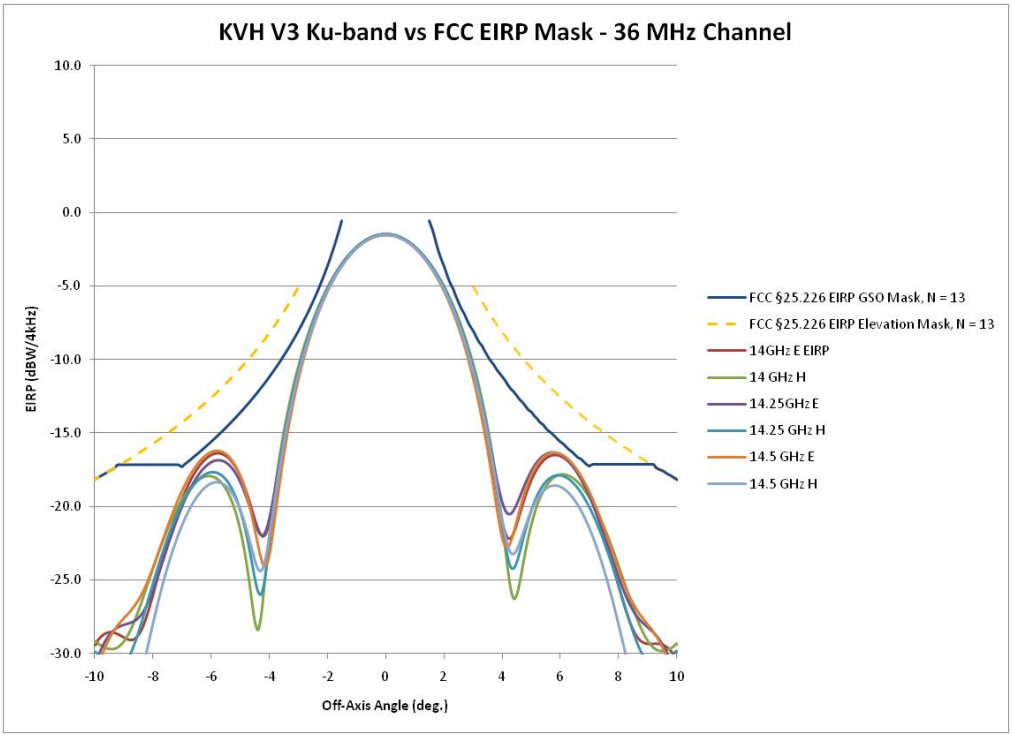

Figure 8 - V3 Off-Axis EIRP Spectral Density – 36 MHz Channel

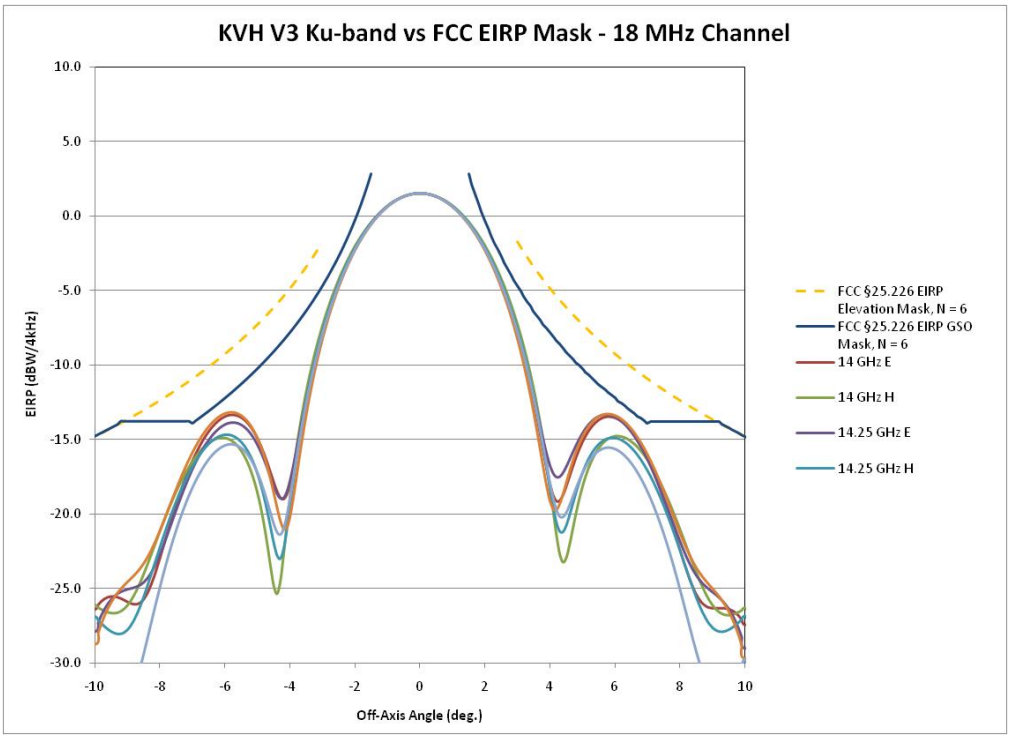

Figure 9 - 3 Off-Axis EIRP Spectral Density – 18 MHz Channel

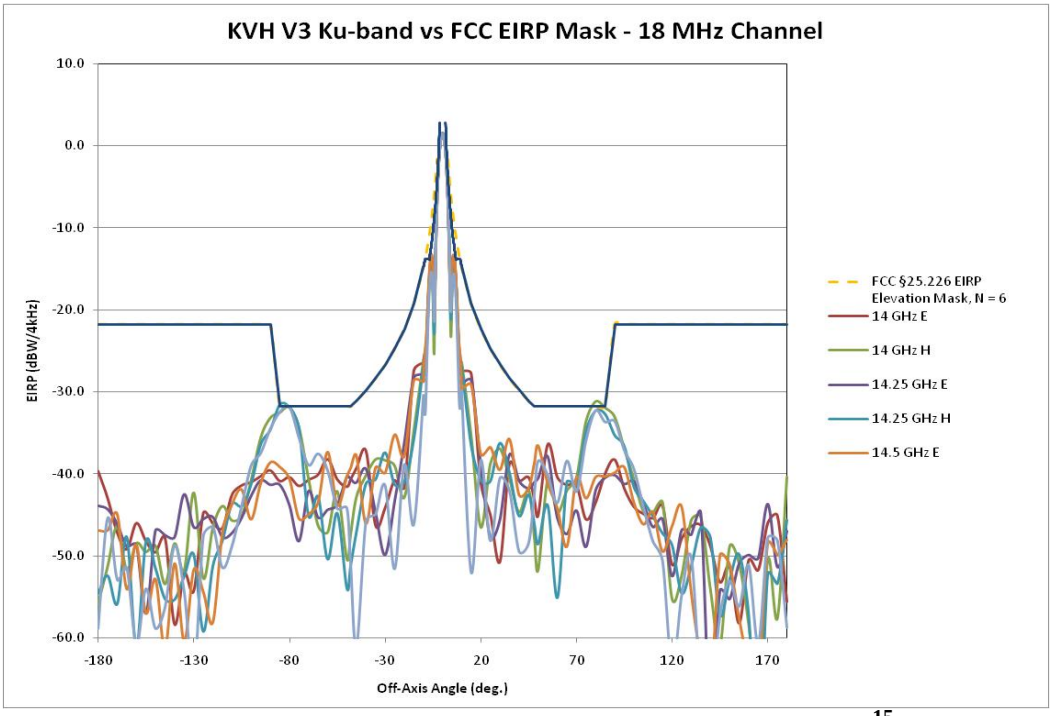

Figure 10 – 18 MHz Off-Axis EIRP Spectral Density[15]

[15] The EIRP envelope exceeds the mask by as much as 1.55 dB between -75 to -85 degrees and +75 to 85 degrees, <5.7% of sidelobes. In accordance with the VMES rules, for angles greater than 7.0°, the envelope may be exceeded by no more than 10% of the sidelobes, provided no

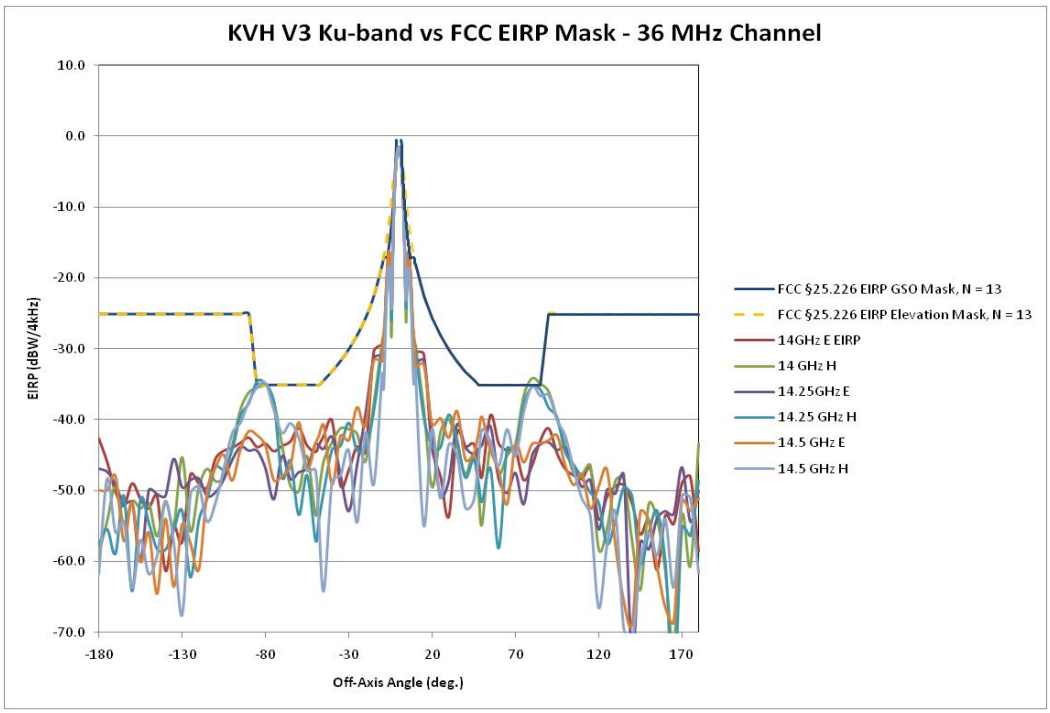

Figure 11 – 36 MHz Channel Off-Axis EIRP Spectral Density

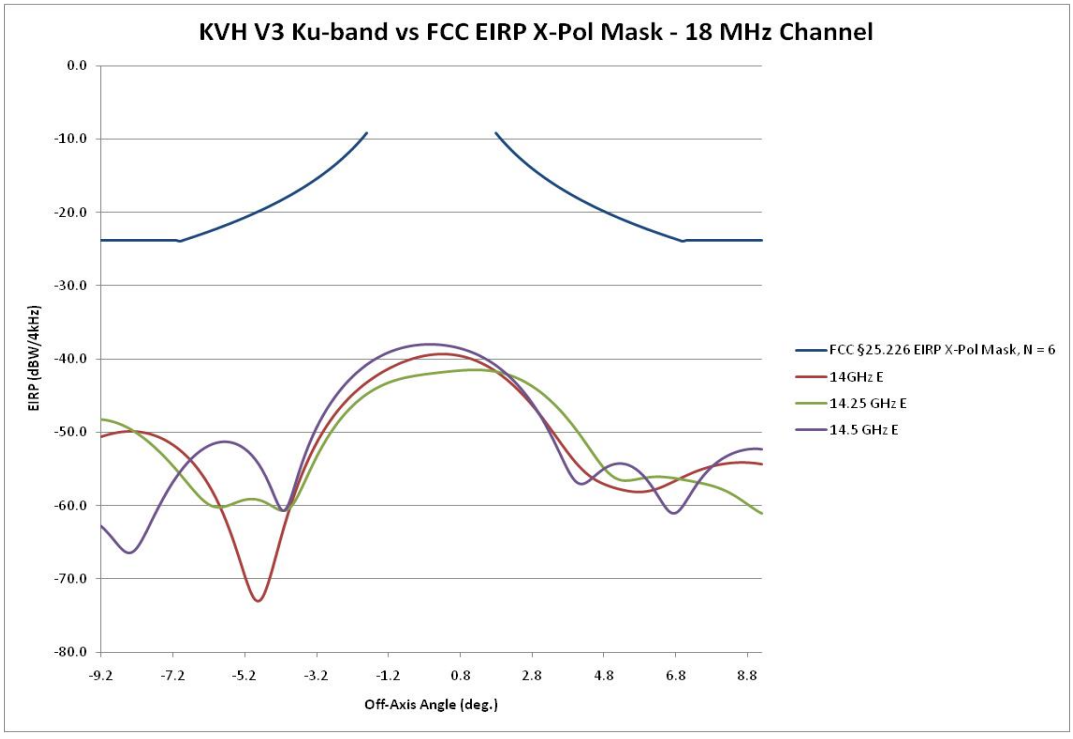

Figure 12 – 18 MHz Channel Cross-Pol Off-Axis EIRP Spectral Density

individual sidelobe exceeds the envelope given above by more than 3 dB. *See* 47 C.F.R. §25.226(a)(1)(i)(A).

KVH has provided in the V7 and V3 Technical Appendices measured antenna gain data required by Section 25.132 of the Commission's rules and, pursuant to Section 25.226(a)(1)(i) and (b)(1), the required tables.[16] Table 1 contains the co-polarized E and H plane antenna patterns for the parabolic antenna, the E and H plane EIRP charts and the Commission's GSO and Elevation masks. Table 2 provides the cross-polarized E and H plane antenna gain and EIRP charts versus the Commission's VMES off-axis EIRP spectral density limits.

The off-axis EIRP spectral density plots, and the antenna gain plots and tables provided in the Technical Appendices, demonstrate that the V7 and V3 terminals comply with the Commission's two-degree spacing policies and the spectral density levels set forth in Section 25.226 of the rules with a minor, theoretical exception for the V7 (discussed in Section II.E.1.b., *infra*). Because the V7 otherwise complies with the off-axis EIRP spectral density limits contained in Section 25.226(a)(1) of the rules and has been fully coordinated in the ESV context and in the context of its prior land mobile STA, no further coordination is required for VMES authorization.

b. Request for Waiver

In the context of preparing the cross-polarization spectral density tables required by the Commission's VMES rules, KVH discovered a minor, theoretical exceedance of the mask for the V7 terminal in a 1.1 degree range at 14.0 GHz (only) when the network operates at its maximum number of simultaneously-transmitting terminals (N=7 using an 18 MHz channel; other transmit frequencies do not show a similar exceedance).[17] KVH does not believe a waiver of the VMES

[16] *See* Technical Exhibit 1, Section 1 and Technical Exhibit 2, Section 4.

[17] KVH did not previously discover this theoretical anomaly because its V7 applications were not prepared with the degree of granularity currently required of VMES and ESV applications. KVH believes that this minor, theoretical exceedance would not require a waiver but, if the

rules is necessary, but identifies this issue out of an abundance of caution. To the extent the Commission concludes that a waiver may be necessary, KVH has respectfully requests a waiver of the Commission's rules with respect to the minor cross-polarization exceedance.

The theoretical 1.6 dB exceedance could occur only if all seven V7 terminals were transmitting simultaneously and in perfect conscan synchronization (*i.e.*, pointed at their maximum declared pointing error in exactly the same direction along the GSO arc towards a victim satellite). As the Commission is aware, the V7 terminals operate using *unsynchronized* circular conscans and thus the possibility of multiple terminals being in perfect alignment is so remote as to be non-existent. Indeed, each V7 terminal is more likely to be pointed away from the GSO arc than along it. Furthermore, the spectral density is reduced by 1.5 dB in the extremely unlikely event that there are five terminals in perfect alignment and by 2.3 dB in the similarly unlikely event that there are four terminals in such alignment.

Table 2 in Technical Exhibit 1 shows that between 6.8° and 7.9° (and -6.8° and -7.9° for the circular antenna), the KVH aggregate emissions exceed the mask for cross-polarization by 1.6 dB or less and only at 14.0 GHz. The potential exceedance is limited to a 1.1 degree range that peaks in a gap between neighboring satellites at two-degree spacing. Further, the minor exceedance would be permitted for co-polarized emissions, but Section 25.226(a)(1)(i)(C) of the Commission's VMES rules does not contain the same 10 percent exceedance allowance at the sidelobes for cross-polarization emissions.

KVH has been operating the V7 terminal for years without incidents of interference and the V7 terminal individually operates in full compliance with the off-axis EIRP spectral density

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Commission concludes otherwise, the V7's multi-year record of interference-free operation strongly supports such a waiver.

limits (including the cross-pol limit). Therefore, to the extent necessary and for the reasons described above, good cause exists for waiver of Section 25.226(a)(1)(i)(C) of the Commission's rules.

2. VMES Terminal Antenna Pointing Control

The V7 and V3 terminals will meet the VMES off-axis EIRP spectral density limits with a declared maximum antenna mispointing of 1.0° and 1.5°, respectively.[18] Upon reaching their declared maximum pointing errors, the terminals will inhibit transmission within 100 milliseconds and, out of an abundance of caution, will not resume until the pointing error value is back to within the average pointing offset of each terminal (*see* below, 0.6º and 0.8º, respectively).[19]

The antenna systems utilize a conical scanning function and rate gyros to stabilize the antenna and keep it pointed properly at the desired satellite. The conscans are currently set to worst case 0.4º and 0.6º from boresight, respectively. The additional dynamic pointing error for the antenna accelerations during in-motion operation is expected to be approximately 0.2º. Thus the total expected mean pointing error for each vehicle in motion, including both conscan and dynamic error, is 0.6º and 0.8º, respectively.

The VMES V7 and V3 terminals utilize a motion-stabilized tracking antenna and a direct sequence spread spectrum ("DSSS") burst modem manufactured by ViaSat to access the satellite. Each terminal will use the CRMA common spreading code and a random access method to

[18] *See* 47 C.F.R. § 25.226(b)(1)(iv)(A).

[19] *See* 47 C.F.R. § 25.226(b)(1)(iv)(B). Although KVH could resume transmission upon bringing pointing offset within the declared maximum pointing errors of 1.0° and 1.5° (for the V7 and V3, respectively), its system is conservatively designed to recommence transmissions when the pointing offset reaches the mean pointing offsets of 0.6° and 0.8°, respectively.

access the satellite. CRMA is closely analogous to the more generally understood code division multiple access ("CDMA") multiple access method, but differs in that all terminals use a common spreading code rather than a number of individual codes for each transmitter. Individual bursts are distinguished by time difference of arrival. The use of this spreading technique allows the EIRP spectral density for each VMES terminal to be significantly lower than typical TDMA systems operating in Ku-band.

The KVH VMES network uses a spread spectrum multiple access technique whereby the individual off-axis EIRP density of each VMES terminal is well below the maximum aggregate network limit. Therefore, each antenna individually will not generate harmful levels of interference even if the antenna were pointed directly at an adjacent satellite. Random pointing errors across the KVH VMES fleet will not cause objectionable levels of adjacent satellite interference because the antenna on each VMES will be pointing in a different direction with a different error component. There is an extremely low probability that multiple antennas will be mispointed at an adjacent satellite at the same time in such a way that results in harmful interference. Because the pointing error is random and momentary, each VMES antenna actually has a higher likelihood of being pointed away from the geostationary satellite arc than at an adjacent satellite in the arc.

The following plots show how random pointing error adds up for the V7 terminal in several cases. In the first plot, Figure 13, a number of different standard deviations of pointing error are plotted: 1.666°, 1.0°, 0.6660, 0.5°, 0.333° and 0.166°. Each plot represents a long term statistical sampling of 1,000,000 random errors for the specified standard deviation. The off-axis EIRP spectral density mask is shown as adjusted to account for the spreading used by each terminal. The ±12.1° of topocentric angle used for theta represent ±10° of geostationary satellite

arc. The reference dBi plot on the charts is representative of the average of the antenna pattern for the topocentric angles to the geostationary arc from various locations in the coverage area.

The second plot, Figure 14, shows the same reference dBi plot representing the aggregate population of terminals with no pointing error. A single terminal with 2° of pointing error is shown. It can be seen that even when the terminal is pointed directly at an adjacent satellite, the power density is well below the VMES off-axis EIRP density mask. In this case, the terminal's input power density has been reduced by an additional 11.8 dB from the network aggregate – equivalent to a population of 15 co-frequency terminals transmitting simultaneously (using the 36 MHz emission).

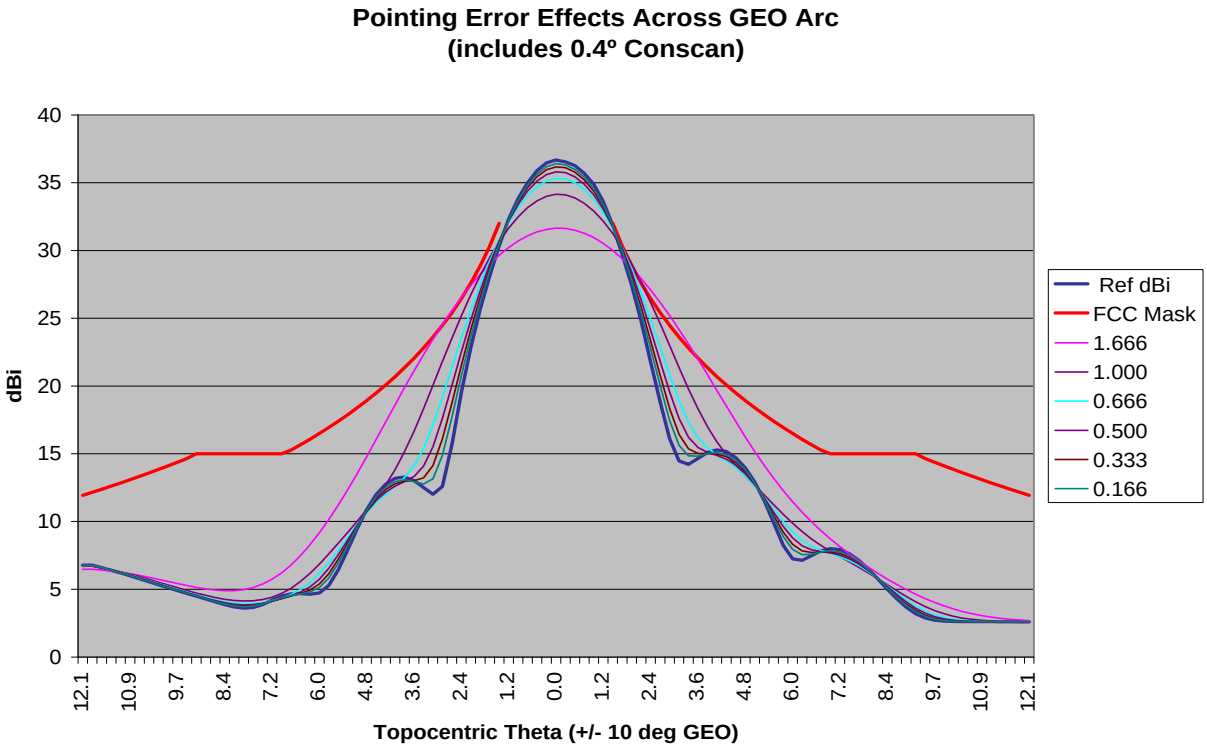

Figure 13 - Aggregate Pointing Error for Several Standard Deviations

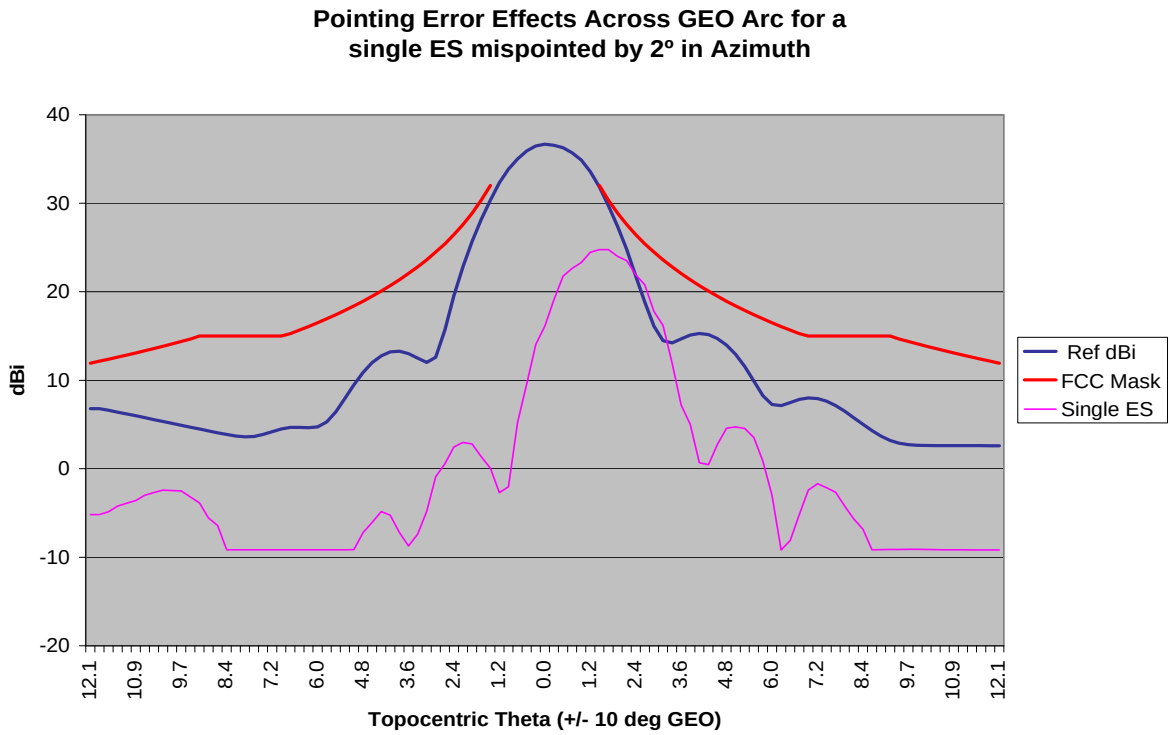

Figure 14. Impact of a Single Terminal with 2° of Pointing Error

Figure 15 shows 15 co-frequency terminals transmitting simultaneously, each with random error fitting the 0.2° standard deviation and with conscan active. The aggregate power summation of all 15 terminals is also plotted along with the reference dBi and adjusted FCC mask.

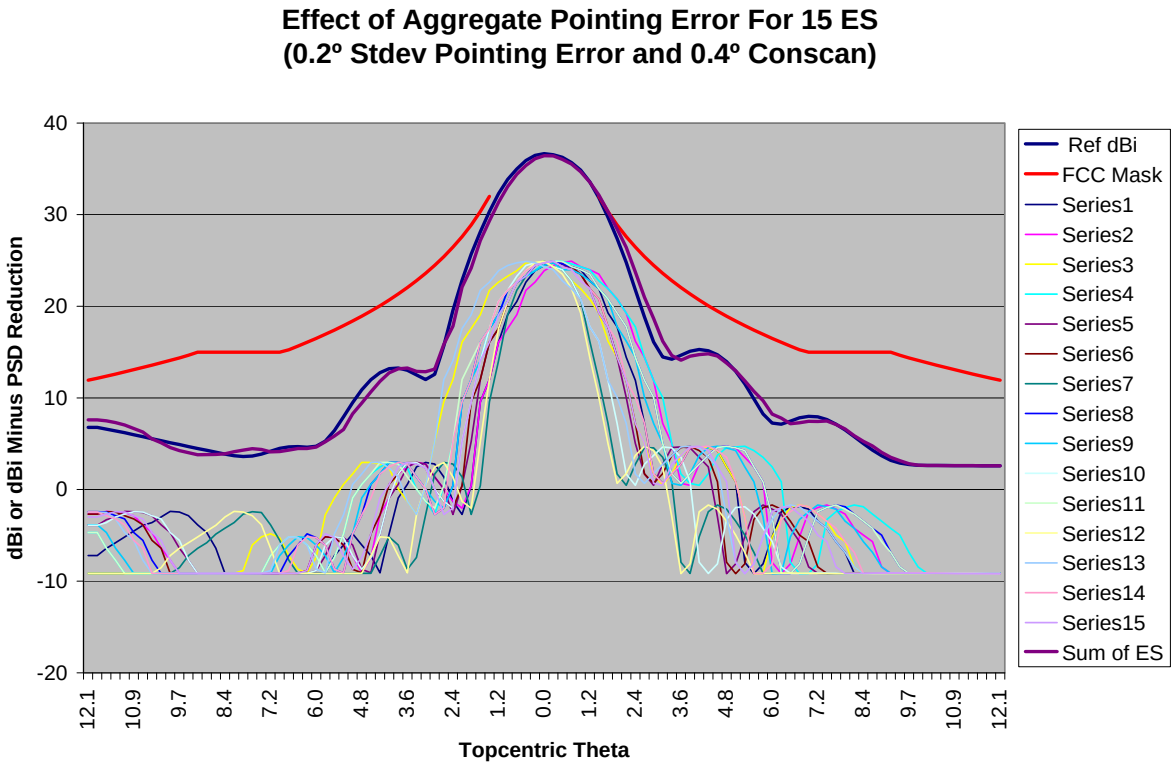

Figure 15 - Aggregate Pointing Error for 15 Co-Frequency Terminals with 0.2° Std Dev Error

The following plots show how random pointing error adds up similarly for the V3 terminal in several cases. In the first plot, Figure 16, the same standard deviations of pointing error are plotted: 1.666º, 1.0º, 0.666º, 0.5º, 0.333º and 0.166º. The VMES mask is shown again as adjusted to account for the spreading used by each terminal. The ±12.8º of topocentric angle used for theta represent ±10º of geostationary satellite arc. The reference dBi plot on the charts is representative of the average of the antenna pattern for the topocentric angles to the geostationary arc from various locations across CONUS.

The second plot, Figure 17, again shows the reference dBi plot representing the aggregate population of terminals with no pointing error. A single V3 with 2º of pointing error is shown. It can be seen that even when the V3 is pointed directly at an adjacent satellite, the power density is well below the Commission's off-axis EIRP density mask. In this case the V3's

input power density has been reduced by an additional 11.8 dB from the network aggregate – equivalent to a population of 15 co-frequency terminals transmitting simultaneously.

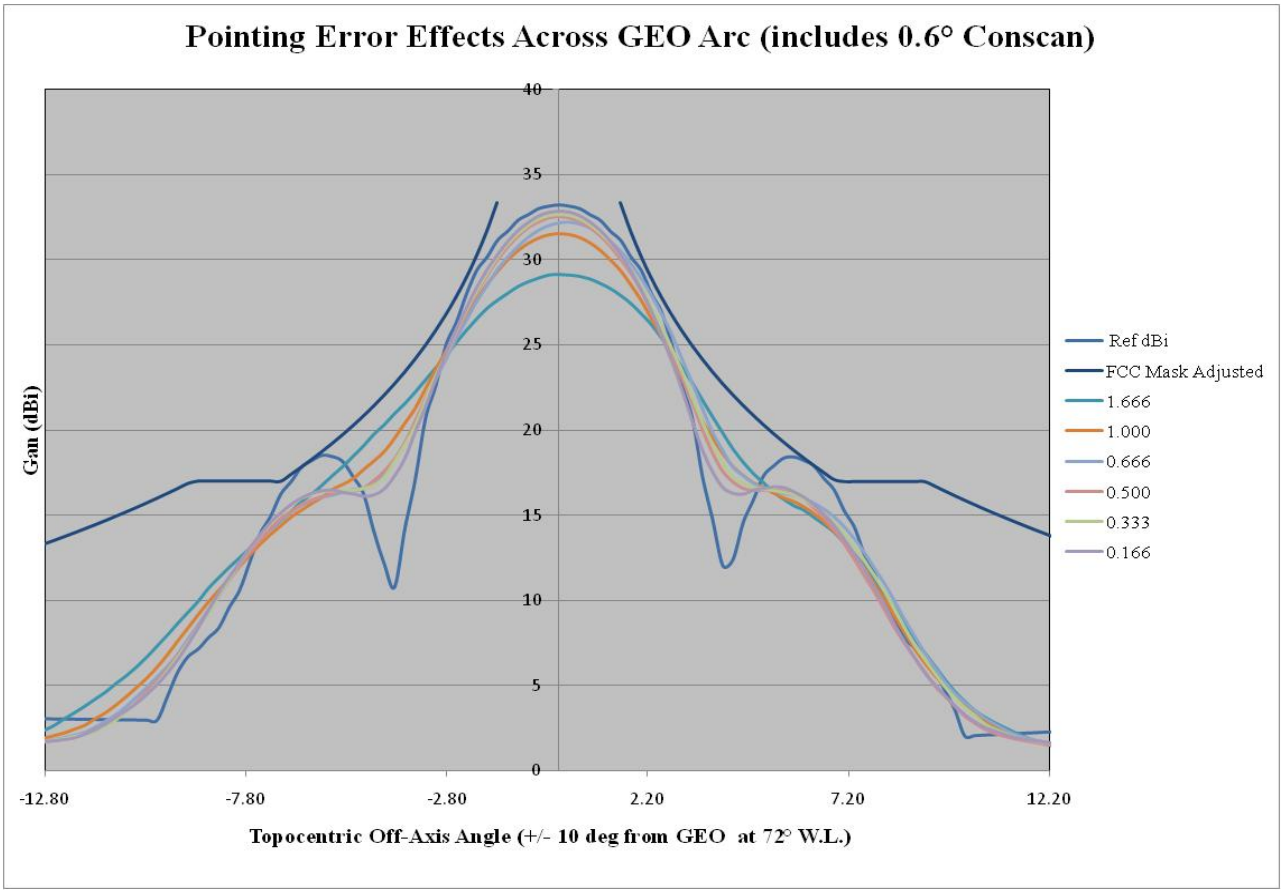

Figure 16– Aggregate pointing error for several standard deviations

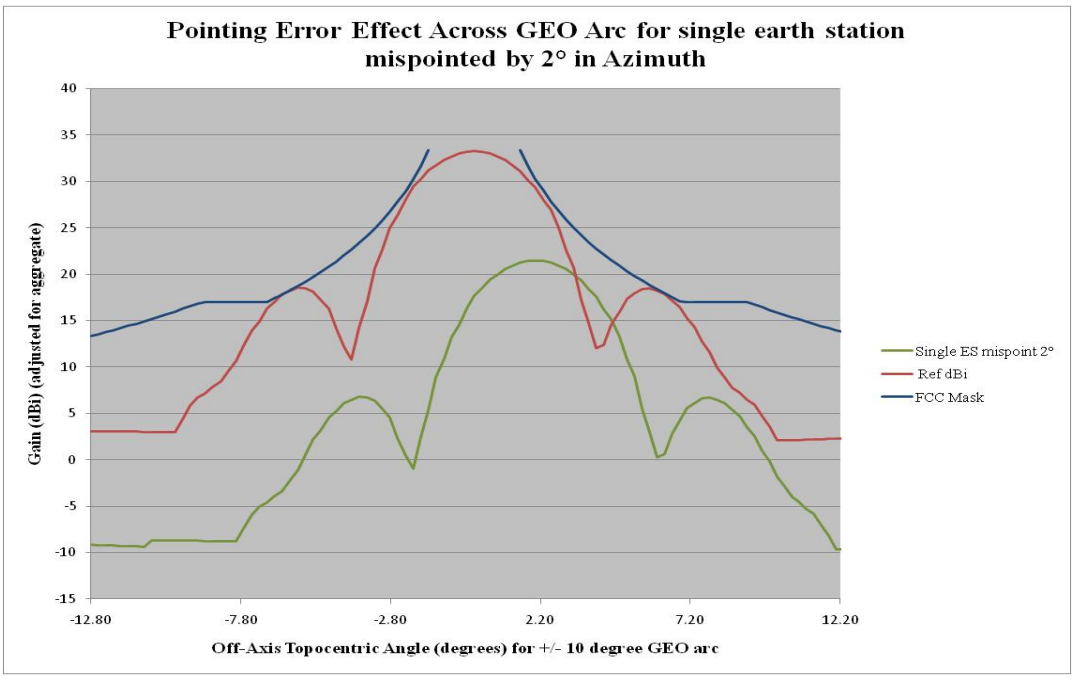

Figure 17– Impact of a single VMES with 2º of pointing error

Figure 18 shows 15 co-frequency V3 VMESs transmitting simultaneously, each with random error and with conscan active. The aggregate power summation of all 15 VMESs is also plotted along with the reference dBi and adjusted FCC mask.

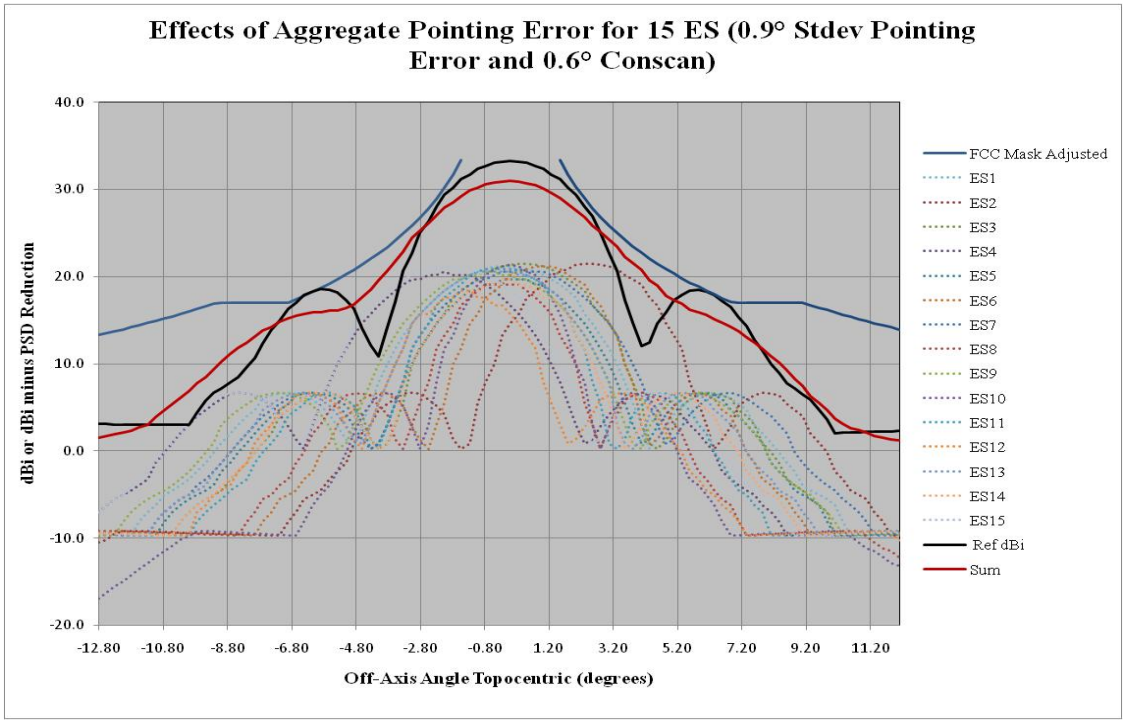

Figure 18 – Aggregate pointing error for 15 co-frequency VMESs

This extremely conservative analysis firmly establishes that V7 and V3 will operate consistent with the Commission's two-degree spacing policies and will not cause harmful interference to other Ku-band operations.

3. Compliance With Additional VMES Requirements

KVH will comply with the additional requirements for VMES applicants.

Section 25.226(a)(5), (b)(6) Points of Contact. The KVH points of contact for the proposed VMES operations, available 24 hours, 7 days a week, with authority to cease all emissions from the VMESs are:

Robert Bourget
KVH Industries, Inc.
Phone: 401.851.3830
Mobile: 401.864.8458
Email: rbourget@kvh.com

The KVH contact information for its network control station in Carlsbad, California is:

6155 El Camino Real
Carlsbad, San Diego County, CA 92009
Tel: 760-476-2583

For filing issues involving this authorization request please contact:

Carlos Nalda
Squire, Sanders & Dempsey (US) LLP
1201 Pennsylvania Ave, NW
Suite 500
Washington, DC 20004
Office: (202) 626-6659
Fax: (202) 626-6780
Cell: (571) 332-5626
Email: carlos.nalda@ssd.com

For technical issues involving this authorization request:

Kenneth G. Ryan, P.E., Skjei Telecom, Inc.
Regulatory Engineering Consultant
Office: (703) 917-4020
Fax: (703) 917-0098
Cell: (703) 919-0361

Email: ken@skjeitelecom.com

Section 25.226(a)(6), (b)(7) Recordkeeping. KVH will maintain, for each VMES transmitter, a time-annotated record of the vehicle location, transmit frequency, channel bandwidth and satellite used for at least one year. The location and time of all transmissions, at time intervals no greater than every 5 minutes while the VMES is transmitting, will be stored on a server at the hub. This information will be sent to the network control facility in Carlsbad, CA. It will be available, as required by the Commission rules, to a coordinator, fixed system operator, FSS operator, the NTIA or the Commission within 24 hours of the request.

Section 25.226(a)(7) Protection Claims. KVH will not claim protection from interference from any authorized terrestrial stations to which frequencies are already assigned or may be assigned in the future, in the 10.95-11.2 GHz and 11.45-11.7 GHz frequency bands.

Section 25.226(a)(8) Protection Limitation. KVH VMES terminals receiving in the 10.95-11.2 GHz, 11.45-11.7 GHz and 11.7-12.2 GHz bands shall receive protection from interference caused by space stations other than the target space station only to the degree to which harmful interference would not be expected to be caused to a 25.209-compliant antenna and stationary at the location at which any interference occurred.

Section 25.226(a)(9) Loss of Reception. The KVH VMES terminals will automatically cease transmitting within 100 milliseconds upon loss of reception of the satellite downlink signal.

Section 25.226(b)(4) Geographic Area of Service. KVH seeking authority to operate its VMES network within the continental United States (CONUS), Alaska, Hawaii and the U.S. territories and possessions.

Section 25.226(b)(8) Radiation Hazard. KVH has included radiation hazard analyses for the V7 and V3 terminals with this application as Exhibits 3 and 4.

4. Protection of Other Users in the 14.0-14.5 GHz Band

KVH's operation of the V7 and V3 antennas will protect other users in the 14.0-14.5 GHz band consistent with the requirements of the Commission's VMES rules.

Protection of Fixed-Satellite Service. As discussed above, KVH's terminals will operate in compliance with the VMES off-axis EIRP spectral density limits, even taking the declared pointing accuracy values into consideration. The VMES limits are consistent with those for routinely licensed VSAT earth stations and are consistent with the Commission's two-degree spacing policies.

Protection of Potential NGSO FSS Systems. KVH acknowledges that non-geostationary orbit ("NGSO") systems are also permitted to operate in the Ku-band. However, no such systems are currently authorized. KVH will undertake adequate protection measures if such systems are authorized in the future. In any event, the V7 and V3 terminals meet the Commission's required off-axis EIRP mask in directions other than the GSO arc.

Protection of Terrestrial Radio Services. KVH has examined current spectrum use in the 14.0-14.5 GHz band and has determined that there are no active FCC-licensed terrestrial services in this band in North America with which its proposed operations would potentially conflict.

Protection of the Radio Astronomy Service. VMES applicants must coordinate through the National Science Foundation ("NSF") any operations in the 14.47-14.5 GHz band within specified distances from an expanded number of radio observatory sites. The KVH VMES terminals will not enter a coordination area (*i.e.*, within the specified distances from any current or future radio astronomy sites) absent completion of coordination and associated

notification under Section 25.226(d) of the Commission's VMES rules**.** KVH will use Global Positioning Satellite ("GPS") location technology to ensure compliance with this requirement.[20]

Protection of Space Research Service. KVH recognizes the utilization of the frequency band from 14.0-14.05 GHz and the possible use of the band from 14.05-14.2 GHz allocated to the National Aeronautics and Space Administration ("NASA") Tracking and Data Relay Satellite System ("TDRSS") for space research conducted at White Sands, New Mexico and Blossom Point, Maryland. For purposes of this application, KVH will avoid VMES operation within 125 km of these earth stations until a coordination agreement is executed with NASA.[21] KVH will use GPS location technology to ensure compliance with this requirement.[22]

III. CONCLUSION

The V7 and V3 terminals are highly efficient and affordable, and have proven their ability to operate consistent with the Commission's rules and policies in the ESV and land mobile context. Indeed, the V7 and V3 terminals have been fully licensed by the Commission as ESVs in the analogous maritime context. Grant of a long-term VMES network license will serve the public interest by extending the reach of affordable and reliable vehicular broadband communications to first responders, newsgathering vehicles, public transportation (*e.g.*, trains), leisure travelers and other users throughout the United States. Accordingly, the Commission should grant the instant VMES application at the earliest practicable time.

[20] *See* 47 C.F.R. § 25.226(e).

[21] *See* 47 C.F.R. § 25.226(c).

[22] *See* 47 C.F.R. § 25.226(e).

Technical Certificate

I, Ken Ryan, hereby certify that I am the technically qualified person responsible for the preparation of the technical discussion contained in KVH Industries, Inc.'s Application for VMES License, that I am familiar with Part 25 of the Commission's Rules (47 C.F.R. Part 25), and that I have either prepared or reviewed the technical information submitted in this Application and found it to be complete and accurate to the best of my knowledge and belief.

By: 

Ken Ryan
Skjei Telecom, Inc.

April 29, 2011