



## **SUMMARY**

KVH Industries, Inc. (“KVH”) hereby submits this application for license modification to add authority to operate up to 250 Ku-100 terminals, a new Ku-band earth station onboard vessels (“ESV”) model that uses a 1m antenna, to its consolidated ESV license. The Ku-100 terminal complies with the Commission’s ESV rules and policies, and will provide high-speed Internet access for various maritime communications applications to private, commercial and government vessels operating in U.S. waters and beyond.

In addition, KVH seeks to add the Telstar 11N satellite at 37.5° W.L. as an authorized point of communications in conventional Ku-band frequencies (11.7-12.2 GHz and 14.0-14.5 GHz), as well as in extended Ku-band receive frequencies (10.95-11.2 GHz and 11.45-11.7 GHz bands), using a gateway earth station located in Laurel, Maryland.

For the reasons set forth herein, grant of this modification application would enhance KVH’s maritime broadband offering and thus strongly serve the public interest.

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**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554**

In the Matter of	)		
	)		
	)		
Application of KVH Industries, Inc. for	)	File Nos.	SES-LIC-20081104-01450
Modification of License to Operate a	)		SES-MOD-20110126-00062
Network of Earth Stations Onboard Vessels	)		
("ESVs") in the 14.0-14.5 GHz (Transmit)	)	Call Signs	E090001
and 10.95–11.2 GHz, 11.45–11.7 GHz and	)		
11.7-12.2 GHz (Receive) Frequency Bands	)		

**APPLICATION FOR LICENSE MODIFICATION**

KVH Industries, Inc. ("KVH"), by its attorneys and pursuant to Section 25.117 of the Commission's rules, 47 C.F.R. § 25.117, hereby submits this application for license modification to add authority to operate up to 250 Ku-100 terminals, an additional Ku-band earth station onboard vessel ("ESV") model that uses a 1m antenna, with its consolidated ESV network license, Call Sign E090001. KVH also seeks to add the Telstar 11N satellite as an authorized point of communication to its ESV network license.

**I. AUTHORITY TO OPERATE THE KU-100 TERMINAL**

The Ku-100 terminal operates in the 14.0-14.5 GHz band (transmit) and 10.95-11.2 GHz, 11.45-11.7 GHz and 11.7-12.2 GHz bands (receive) and, as demonstrated below, complies with the Commission's Ku-band ESV rules and policies, 47 C.F.R. § 25.222.

**A. Description of the Ku-100 Terminal**

The Ku-100 terminal employs a 1m 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 an eight watt (8W) block upconverter. The Ku-100 (otherwise known as the Ku-Mate) antenna description and specifications are included as Exhibit 1.

The proposed ESV uplink return transmission (inbound) channel supports data rates of 32 kbit/s, 64 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, 27 MHz and 36 MHz. A summary of the Ku-100 terminal operating characteristics are set forth in Tables 1 and 2 below.

Antenna diameter	100 cm
Type of Antenna	Parabolic rear-fed
Peak Power (SSPA)	8 watts
Transmit Bandwidth	18, 27, 36 MHz
Transmit Gain	41.8 dBi at 14.25 GHz
EIRP	49 dBW (does not include 0.7 dB radome loss)
Transmit Data Rate	32 kbps to 512 Mbps
Transmit Polarization	Horizontal or Vertical
Transmit Azimuth, Elevation Beamwidth	1.35 degrees
Receive G/T	19.5 dB/K minimum
Receive Bandwidth	500 MHz
Receive Polarization	Dual Vertical and Horizontal

**Table 1. Ku-100 Terminal Operating Parameters**

Azimuth	continuous coverage over full 360°
Elevation	10° to 90° antenna elevation
Position accuracy	Pointing error 0.2° RMS (AZ), incl. 0.1 ° conscan
Dynamic Tracking capability	Meets: 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 <sup>2</sup> acceleration

**Table 2. Ku-100 Terminal Antenna Control Parameters**

The target end users of this terminal are vessels operated by private, commercial and government customers, including leisure vessels, fishing boats, cargo ships and United States

military vessels. Like KVH's other ESV terminals, the Ku-100 terminal will provide high-speed connectivity for a range of maritime communications applications such as e-mail, Internet access and voice services. Adding this terminal will enhance the range of customers that will benefit from KVH's advanced, broadband maritime service.

**B. Telstar 11N Satellite**

In the instant application, KVH requests authority to operate in the conventional Ku-band 14.0-14.5 GHz uplink and 11.7-12.2 GHz downlink spectrum, as well as in the extended Ku-band downlink frequencies (10.95-11.2 GHz and 11.45-11.7 GHz bands) with the Telstar 11N satellite at 37.5° W.L.<sup>1</sup> The Commission's ESV rules authorize receive operations in these additional bands.<sup>2</sup>

KVH's ESV network is controlled by the network control center in Carlsbad, California.<sup>3</sup> ESV communications with Telstar 11N will be conducted through a gateway earth station located in Laurel, Maryland, Call Sign E020288. KVH will exercise control over its ESV terminals at all times.

**C. Emissions Designators**

KVH seeks in the instant application to operate the Ku-100 with bandwidths of 18 MHz, 27 MHz and 36 MHz. The requested emissions designators are as follows:

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<sup>1</sup> 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. § 25.222(a)(7).

<sup>2</sup> *See* 47 C.F.R. §§ 25.202(a)(8); 25.222(a).

<sup>3</sup> KVH maintains ultimate direction and control of its Ku-band VMES operations via a network management agreement with ViaSat, Inc.

<b>Satellite</b>	<b>Frequencies</b>	<b>Emissions Designators</b>
Telstar 11N	10.95-11.2 Receive	18M0G7D, 36M0G7D
	11.45-11.7 Receive	18M0G7D, 36M0G7D
	11.7-12.2 Receive	18M0G7D, 36M0G7D
	14.0-14.5 Transmit	18M0G7D, 36M0G7D
GE-23 at 172° E.L.	10.95-11.2 Receive	18M0G7D, 27M0G7D, 36M0G7D
	11.45-11.7 Receive	18M0G7D, 27M0G7D, 36M0G7D
	11.7-12.2 Receive	18M0G7D, 27M0G7D, 36M0G7D
	14.0-14.5 Transmit	18M0G7D, 27M0G7D, 36M0G7D

**D. Compliance with the Ku-band ESV Rules**

The Ku-100 terminal complies with Commission rules and policies designed to protect other users of the Ku-band from harmful interference from ESV transmit operations.

**1. Off-Axis EIRP Spectral Density Limits**

KVH acknowledges that the small diameter Ku-100 antenna does not meet the Commission’s Section 25.209 antenna pattern by a very small margin.<sup>4</sup> However, KVH certifies that the aggregate EIRP levels do not exceed the limits specified for Ku-band ESVs in Section 25.222 of the Commission’s rules.

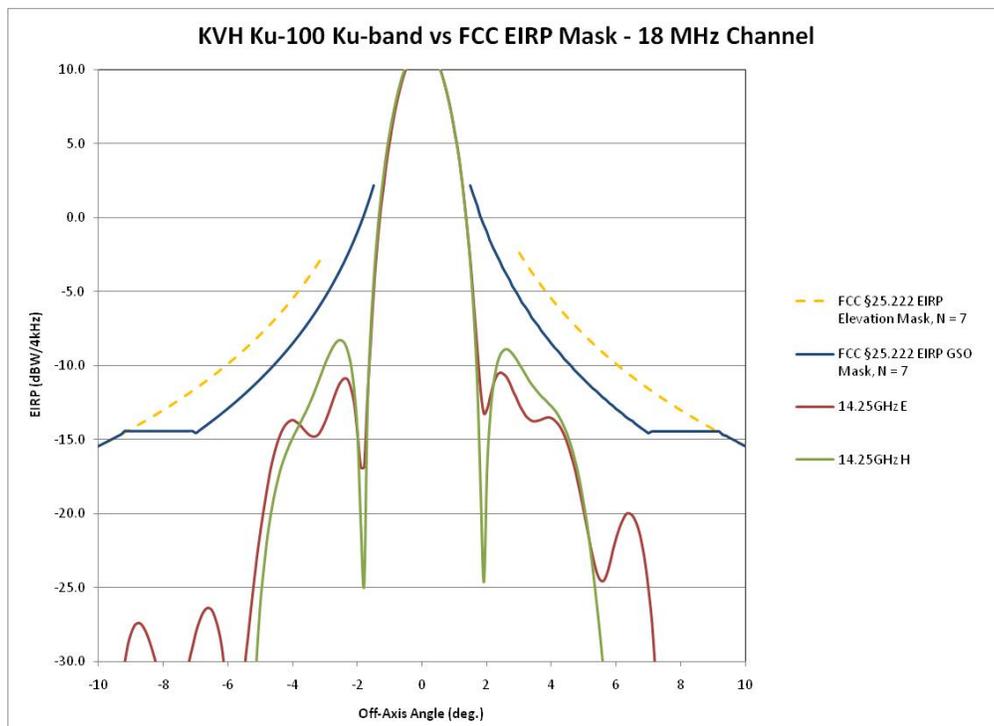
The Ku-100 will operate in accordance with the off-axis EIRP spectral density limits for

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<sup>4</sup> See 47 C.F.R. § 25.222(b)(1)(ii) and antenna gain patterns included in Exhibit 2, Section 4.

Ku-band ESV terminals in the Commission’s rules.<sup>5</sup> The data rates transmitted from the terminal will vary between 32 kbits/s and 512 kbits/s. Additionally, the ESVs will transmit using CRMA spreading<sup>6</sup> over an 18 MHz, 27 MHz or 36 MHz channel bandwidth.

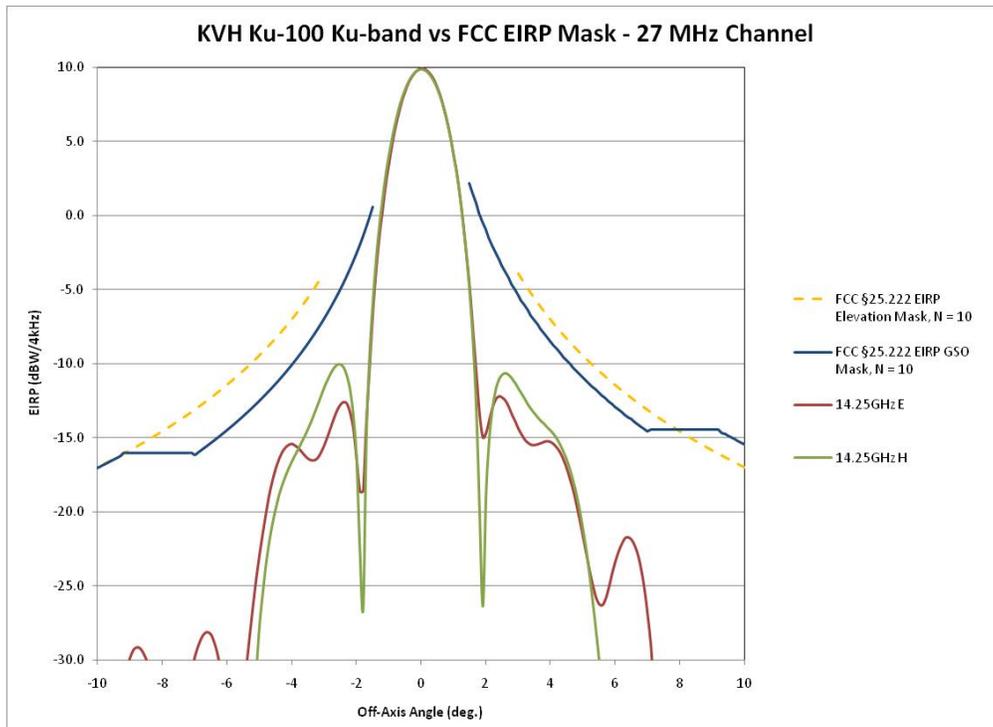
The co-polarized off-axis EIRP spectral density levels of the KVH ESV terminal are shown in Figures 1 through 6 below at +/-10 degrees and +/- 180 degrees off-axis angle. Note that a calculated aggregate EIRP considers N=7 users for the 18 MHz channel, N=10 for the 27 MHz channel and, N=14 users for the 36 MHz channel. This represents a worst case operational scenario for this terminal type. Figure 7 below shows the Ku-100 worst case cross-polarization off-axis EIRP density plots versus the Commission’s Section 25.222 mask.



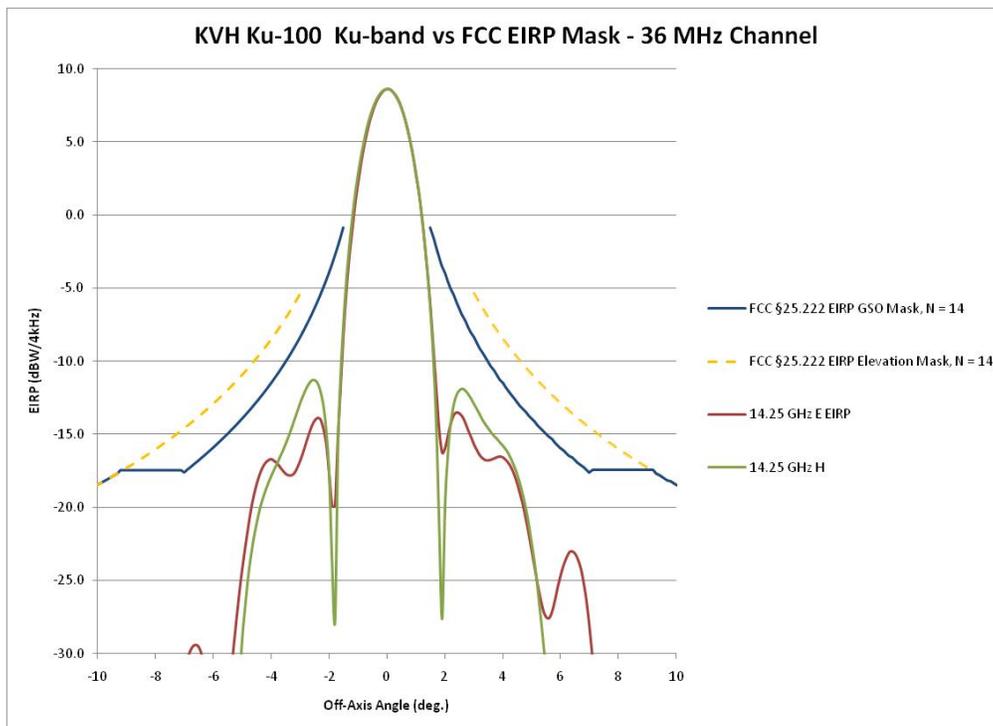
**Figure 1 – Off-Axis EIRP Spectral Density 18 MHz Channel (+/- 10 deg.)**

<sup>5</sup> See 47 C.F.R. § 25.222(a)(1)(i). The Ku-100 terminal complies with off-axis EIRP spectral density limits in both the azimuth and elevation plane.

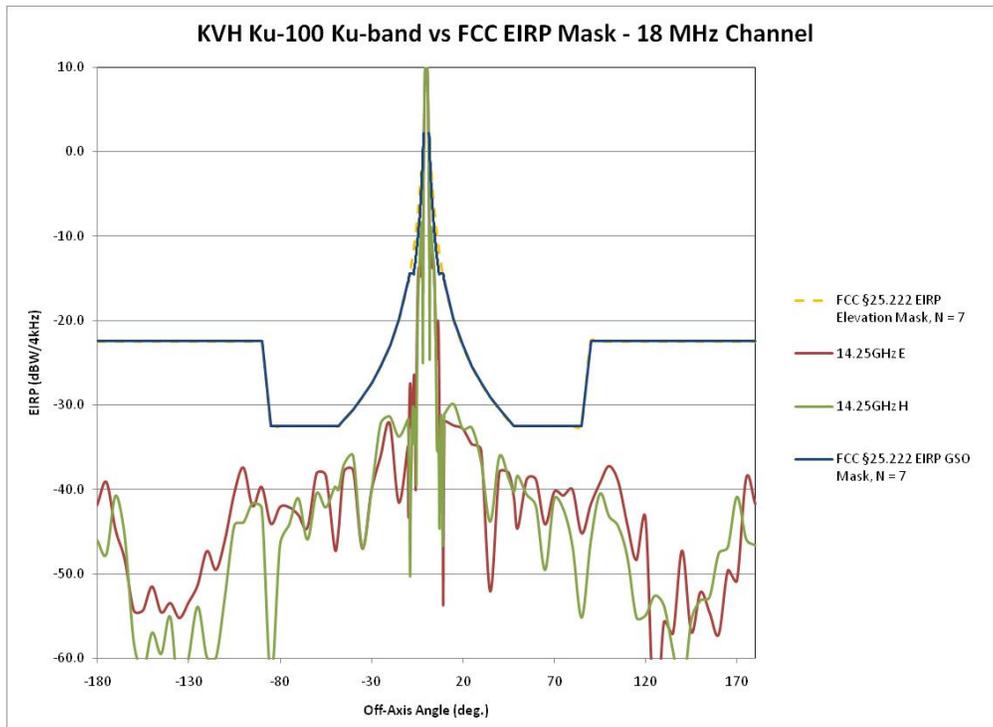
<sup>6</sup> CRMA, or Code Reuse Multiple Access, is a ViaSat proprietary spread spectrum technique, similar to CDMA, used in the ArcLight satellite system. See *infra* p. 9.



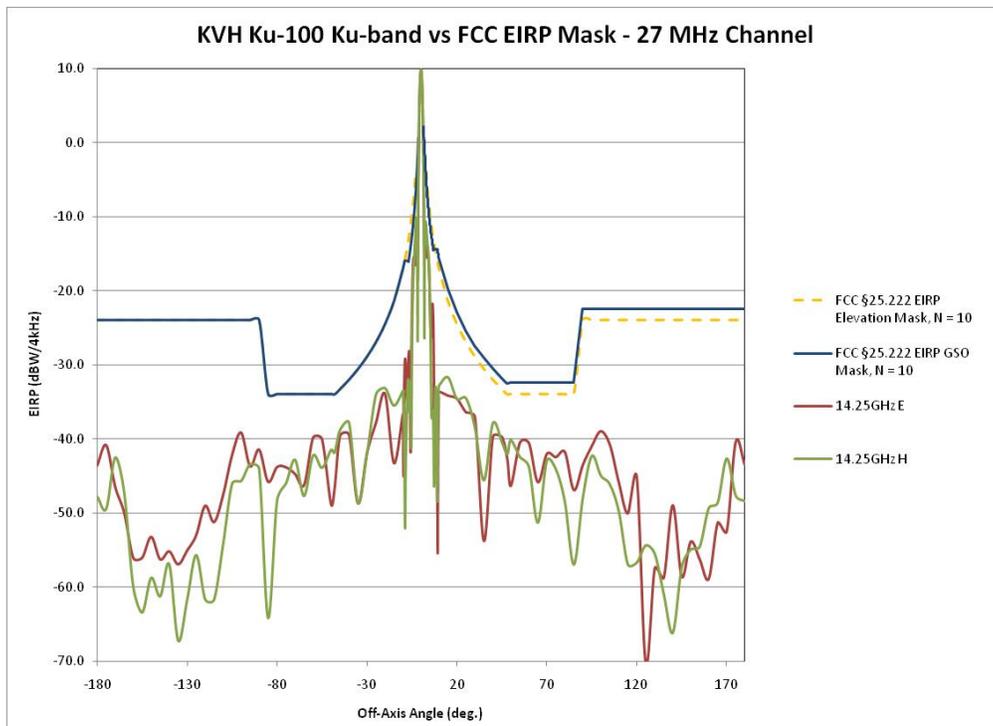
**Figure 2 - Off-Axis EIRP Spectral Density 27 MHz Channel +/- 10 degrees**



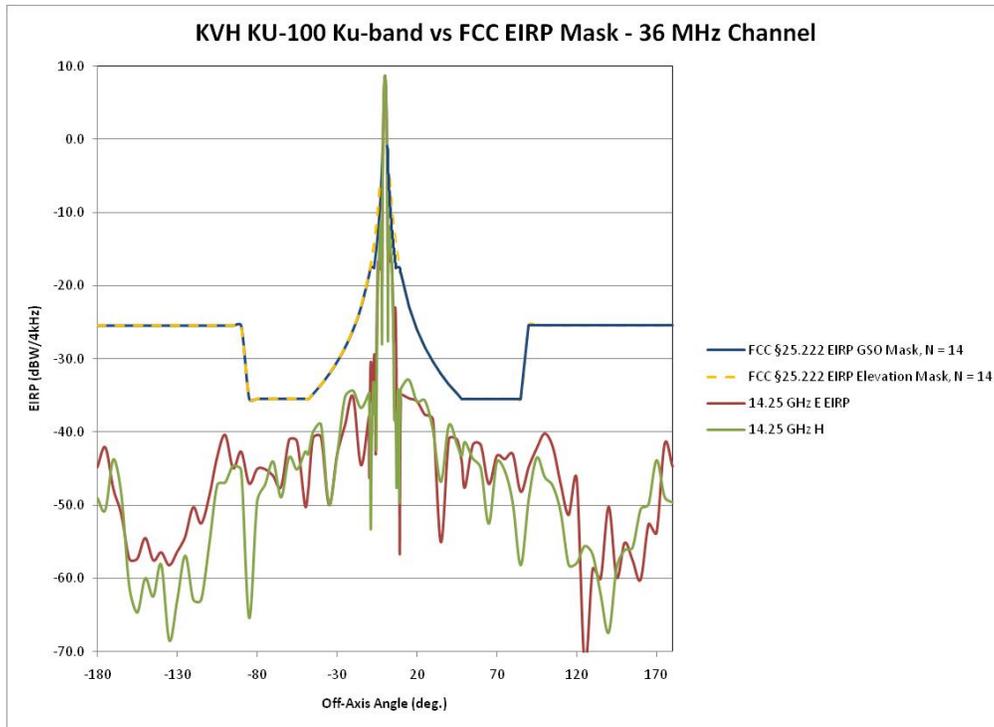
**Figure 3 - Off-Axis EIRP Spectral Density 36 MHz Channel +/- 10 degrees**



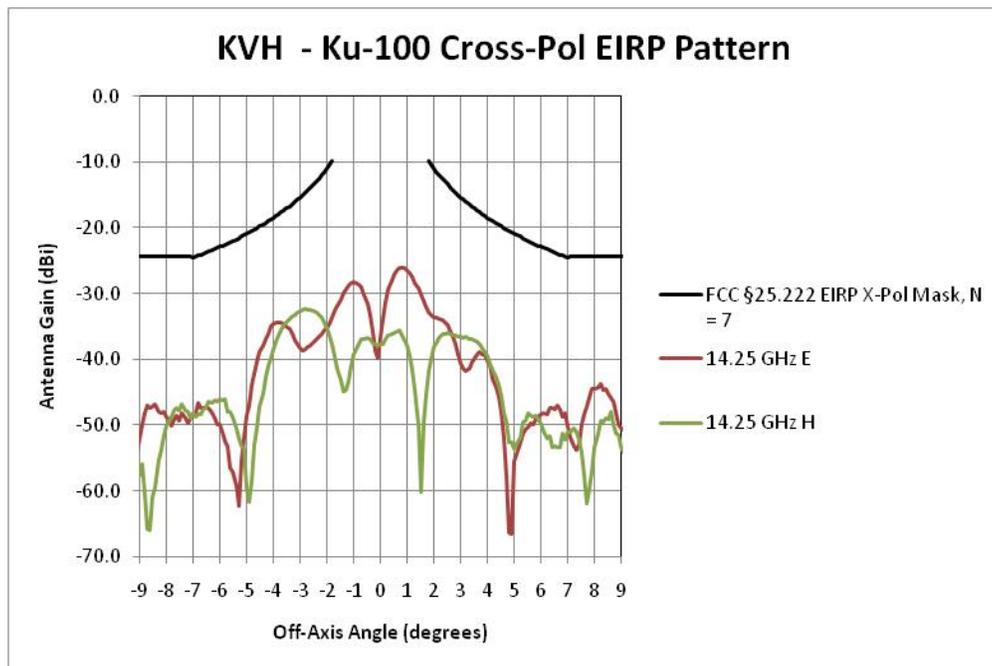
**Figure 4 – 18 MHz Off-Axis EIRP Spectral Density +/- 180 degrees**



**Figure 5 – 27 MHz Channel Off-Axis EIRP Spectral Density +/- 180 degrees**



**Figure 6 – 36 MHz Channel Off-Axis EIRP Spectral Density +/- 180 degrees**



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

KVH has provided in Exhibit 2 measured antenna gain data required by Section 25.132 of the Commission's rules.<sup>7</sup> In addition, pursuant to Section 25.222(a)(1)(i) and (b)(1), KVH has included in Exhibit 2 the required tables.<sup>8</sup> 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-polarization E and H plane antenna gain and EIRP charts versus the Commission's ESV off-axis EIRP spectral density limits. The foregoing off-axis EIRP spectral density plots, and the attached antenna gain plots and tables, demonstrate that the Ku-100 terminal complies with the spectral density levels set forth in Section 25.222 of the rules and the Commission's two-degree spacing policies.

Each terminal will use the CRMA common spreading code and a random access method to 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 ESV to be significantly lower than typical TDMA systems operating in Ku-band. This technique is successfully used by KVH's other ESV terminals, which are smaller than the Ku-100, to operate without causing interference to other Ku-band satellite operations.

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<sup>7</sup> KVH has provided values for 14.0 GHz in Table 1 and for 14.25 and 14.5 GHz for Table 2, which are the measured values available. KVH requests a limited waiver of the Section 25.132(b)(1) requirement for measured values at the bottom, middle and top of each allocated frequency band to the extent necessary. *See infra* Section I.D.5.

<sup>8</sup> *See* Exhibit 2.

## 2. Ku-100 Terminal Antenna Pointing Control

The Ku-100 ESV terminal complies with Section 25.222(a)(ii)(A) of the Commission's ESV rules and will maintain a pointing error of less than or equal to  $0.2^\circ$  between the orbital location of the target satellite and the axis of the main lobe of the antenna.<sup>9</sup> Upon reaching mispointing of  $0.5^\circ$ , the terminal will inhibit transmission within 100 milliseconds and will not resume until the pointing error value is back to within  $0.2^\circ$ .<sup>10</sup> The manufacturer specifications are included as Exhibit 1.<sup>11</sup>

The antenna pointing accuracy is maintained by the Antenna Control Unit, which tracks the satellite; a built-in tracking receiver to measure RX signal strength; and the GPS receiver, which provides latitude and longitude. The Ku-100 antenna also uses a  $0.1^\circ$  conical scan to peak the signal and maintain accurate antenna pointing. Overall pointing accuracy is maintained within  $0.2^\circ$  even including the  $0.1^\circ$  conscan.

## 3. Compliance With Additional ESV Requirements

KVH will comply with the additional requirements for ESV applicants, as indicated in its previous license applications and grants of operating authority. Additional information is provided below.

**Points of Contact.** The KVH points of contact for the proposed ESV operations, available 24 hours, 7 days a week, with authority to cease all emissions from the ESVs are:

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<sup>9</sup> See 47 C.F.R. § 25.222(a)(ii)(A).

<sup>10</sup> See 47 C.F.R. § 25.222(a)(iii)(A).

<sup>11</sup> See 47 C.F.R. § 25.222(b)(1)(iii).

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

The contact information for the gateway station in Laurel, Maryland associated with the Telstar 11N satellite is:

9898 Brewers Court  
Laurel, Howard County, MD 20723  
Tel: 240-553-9403

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](mailto: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](mailto:ken@skjeitelecom.com)

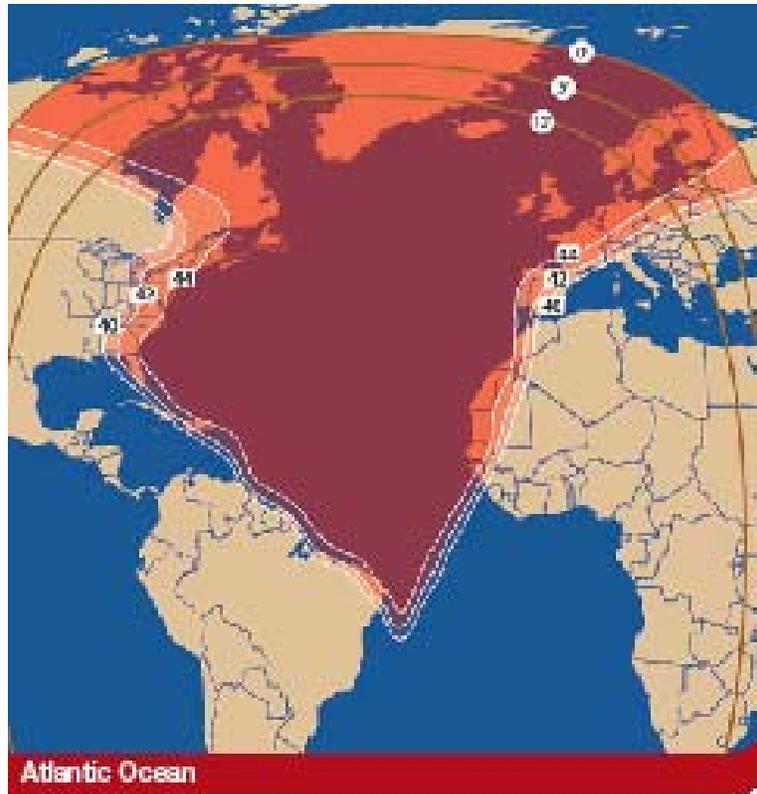
**Geographic Area of Service.** KVH is authorized to operate within the continental United States (CONUS), Alaska and Hawaii, as well as U.S. territories and possessions and adjacent waters within the satellite coverage zones. This includes North America and its coastal

waters, Central America, the Gulf of Mexico and the Caribbean, as well as large portions of the Atlantic and Pacific Oceans as shown below.



**Figure 8 – Current ESV Coverage Area**

The addition of the Telstar 11N satellite expands KVH’s current ESV coverage area under FCC authority to include large portions of the Atlantic Ocean, as indicated in Figure 9, below. The additional coverage will enhance the benefits of KVH’s broadband maritime service to a wider range of users and geographic areas.



**Figure 9 – Atlantic Ocean Coverage Area**

**Section 25.222(b)(5) Radiation Hazard.** KVH has included a radiation hazard analysis for the Ku-100 with this application as Exhibit 3.

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

KVH’s operation of the Ku-100 antennas will protect other users in the 14.0-14.5 GHz band consistent with the requirements of the Commission’s ESV rules.

**Protection of Fixed-Satellite Service.** As discussed above, KVH’s terminals will operate in compliance with the ESV off-axis EIRP spectral density limits and pointing accuracy requirements. The ESV 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 Ku-100 terminal meets the required FCC 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.** KVH will comply with its prior coordination agreement with the National Science Foundation to protect radio astronomy service sites listed in Section 25.222(d) of the rules.<sup>12</sup>

**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 NASA TDRSS for space research conducted at White Sands, New Mexico and Blossom Point, Maryland. For purposes of this application, KVH will avoid ESV operation within 125 km of these earth stations until a coordination agreement is executed with NASA.<sup>13</sup>

## **5. Waiver Request**

As noted in Section I.D.1, *supra*, KVH has submitted substantial measured data on the Ku-100 ESV terminal. This is all the data available to KVH from the terminal manufacturer, Mitsubishi Electric Corporation (“MELCO”), and was prepared before the current ESV rules took effect. Indeed, although the Ku-100 terminal has been deployed throughout Europe and

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<sup>12</sup> Coordination Agreement with the National Science Foundation, submitted with a letter dated November 20, 2008 in IBFS File No. SES-LIC-20081104-01450.

<sup>13</sup> See 47 C.F.R. § 25.222(c).

Asia, it was originally developed for the Connexion by Boeing Maritime service (which ceased commercial operation in December 2006).

KVH has submitted complete tabular co-polarized information at 14.0 GHz and cross-polarization information at 14.25 GHz, but measured data at other bands is unavailable. KVH respectfully submits that this information is sufficient to demonstrate compliance with the FCC's two-degree spacing policies and the off-axis EIRP limits for Ku-band ESVs, particularly since the Ku-100 terminal has been operating successfully for more than half a decade. Accordingly, to the extent necessary, KVH requests a limited waiver of Section 25.132(b)(1)'s requirement for measured values at the bottom, middle and top of each allocated frequency band.

There is good cause for such a waiver. Significantly, individual Ku-100 terminals operate well below the permissible off-axis EIRP density limits and approach the mask only when the number of simultaneously transmitting terminals (N) equals 7 users for the 18 MHz channel, 10 for the 27 MHz channel and 14 users for the 36 MHz channel. This would rarely, if ever, be the case. In addition, KVH has established over the past several years that it is more than capable of operating multiple ESV terminals with differing technical characteristics without any incidents of interference. The addition of the proven Ku-100 terminal to KVH's ESV network will in no way affect KVH's operational control of the network. Thus, to the extent necessary, a limited waiver of Section 25.132(b)(1) is warranted in this case.

## **II. CONCLUSION**

The Commission should authorize operation of up to 250 Ku-100 terminals as part of KVH's ESV network to extend broadband communications to vessels at sea. The Ku-100 terminal complies with the Commission's ESV rules and policies consistent with the Commission's of two-degree spacing policies. Addition of these terminals to the KVH ESV blanket license would strongly serve the public interest by enhancing competition in broadband maritime services and maintaining U.S. leadership in advance communications connectivity. Because the requested modifications are consistent with the Commission's ESV rules and policies, KVH respectfully requests action on this application at the earliest practicable time.

## 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 License Modification, 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.

June 9, 2011

# **EXHIBIT 1**



# Ku-Mate® (SX-5300)

Ku-Band  
Maritime antenna terminal equipment



Photo: SX-5300 ADU

#### FEATURES:

1. 1 meter dish with 8W Block up converter (BUC)
2. Eutelsat EESS 502 STANDARD M approved  
(Certificate: EA-V056)
3. Comply with IEC60945 (environmental condition)
4. Robust and reliable antenna control keeping satellite tracking error of  $\pm 0.2$ deg. compliant with ITU-R requirement under severe vessels motion and vibration condition
5. 3-axes stabilized mount for full hemispherical coverage at severe motion condition
6. Single IF cable between ADU and BDU multiplying Transmit, Receive and control signal
7. Compatible with worldwide deployed modems from various suppliers
8. Quickly and easily replaceable components for easy maintenance

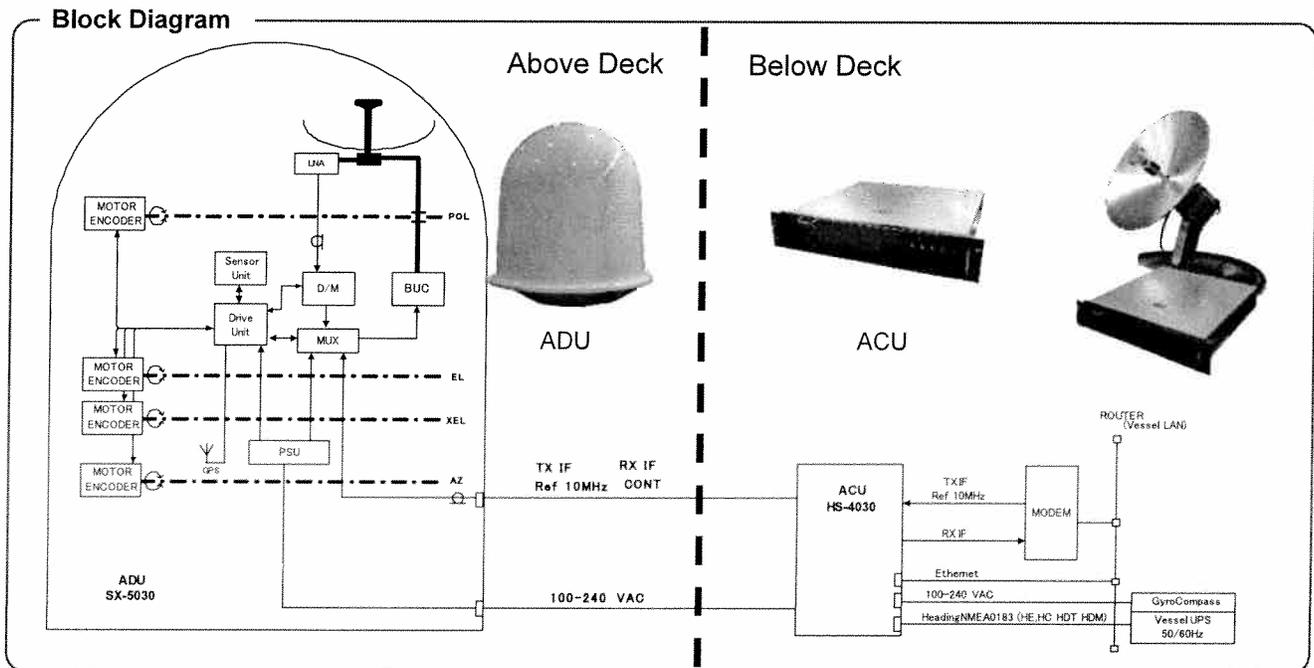
Mitsubishi Electric Corporation (MELCO) Ku-band Maritime Mobile Satellite antenna is designed for ESV (Earth Station on the Vessel) applications. The antenna receives linearly polarized signals from a GEO satellite having down link frequencies in the 10.95 – 12.75 GHz band, covering the Ku band frequency allocations. Transmission to the satellite is linearly polarized in the 14.00 – 14.50GHz band (13.75GHz–14.50GHz option), using an 8 watt Block Up Converter(BUC) for high data rate transmission. The LNA is mounted on the backing structure of the antenna reflector. The IF frequency is in the 950 – 1,700 MHz (Rx) 1,450 MHz(Tx) band.

The antenna is controlled by the Antenna Control Unit (ACU) to track the satellite. The ACU determines the vessel's attitude and Az/EI estimates as provided by rate sensors in the antenna and maximize received signal strength by conical scan. The RX signal strength is provided by a built-in tracking receiver in the ACU. The angles toward a targeted satellite can be determined by calculation from the ship location (latitude and longitude from the GPS receiver) and the stored data in the ACU on the orbital position of the satellite. TX and RX frequencies, modulation scheme and data such as link parameters for the satellite must be provided. The transmitting carrier can be automatically disabled if the vessel intrudes within 125 km of the territory of a country that prohibits transmission from a foreign ESV, and also it is possible to disable this function manually.

## Major Performance Specifications for Ku-Mate<sup>®</sup> SX-5300

Item		1m Antenna
Antenna	Reflector Size	1m
	Radome Size	Approx. 1.60m(D) x 1.75m(H)
	Weight	Approx. 175kg
	Mount	3-axis servo control
RF/IF Frequency	Transmit	14.00 - 14.50 GHz / 950 - 1,450 MHz 13.75 - 14.50GHz / 950-1,700MHz(option)
	Receive	10.95 - 12.75 GHz / 950 - 1,700 MHz
Polarization	Transmit	Linear
	Receive	Linear
Cross Polarization Discrimination	Transmit	>27dB
	Receive	>20dB
System EIRP		49.0dBW typ. @14.25GHz with 8W BUC
System G/T		18.4dB/K typ. @12.50GHz
Tracking	Method	Conical Scan + Rate Sensor
	Accuracy	+/- 0.2 deg. (o-p)
Gimbal Angle Coverage	Az	540 deg. (continuous)
	El	-25 to +115deg.
Wind Load	Average	40m / sec
	Maximum	60m / sec
Vessel Motion	Roll	+/-30deg/ 7sec
	Pitch	+/-10deg/ 5sec
	Yaw	+/- 4deg/ 20sec
	Turning Rate	+/- 6deg/sec
Vessel I/F	Navigation	Gyro Compass (NMEA0183)
Environmental Condition (*)	Temperature	-25 to +55 degC
	Damp-Heat	+40degC 93%RH 1cycle
Power Supply		100-240VAC 50/60Hz +/-5%

(\*Note) Comply with IEC60945



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