Global VSAT Forum

GVF-107

APPLICATION FOR GVF TYPE APPROVAL

This document defines the applicable data to provide in order to apply for a type approval of an antenna system with a satellite operator.

REVISION HISTORY

Issue/Revision	Revision Date	Contributors
1/0	Mar 2012	Eutelsat
2/0	4 Apr 2012	SES
3/0	3 May 2012	Intelsat, Inmarsat, GVF

A Summary Of The Type Approval Process

Since the 80s, leading satellite organisations have maintained an antenna Type Approval program, to encourage manufacturers to develop high performance product lines and to improve existing systems, the effective deployment of which is instrumental in the prevention of satellite radio frequency interference.

The Type Approval of earth station antennas depends on the ability to manufacture the antenna system with repeated precision.

Widespread use of CNC tools makes it possible to manufacture certain types of antennas with repeated precision. Other earth station equipment (LNA, HPA, U/C, D/C etc.) can also be repeatedly manufactured precisely.

The advantage of Type Approval is that satellite end users will be able to introduce type approved antenna/earth station units, without the need for full verification testing or certification of the performance characteristics, by simply notifying the satellite operator, as foreseen within the application form.

The Mutual Recognition Arrangement (MRA) provides in the document GVF-101 guidance for manufacturers and satellite operators pursuing GVF MRA Testing and Satellite System Operator Type Approval for VSAT equipment.

The GVF may be delegated by a Satellite System Operator to perform the Type Approval process on its behalf, through one of its Authorized test Entities (GVF/ATE). In this case the Satellite System Operator will recognize and honour the GVF Type Approval on an equal footing with those performed in the past.

The high level step by step procedure is the following:

1. **Manufacturer** chooses a Satellite Operator or GVF/ATE and designates other Satellite Operators, as applicable.

2. **Manufacturer** submits to Satellite Operator or GVF/ATE the relevant documentation, including the application form here below, product specification sheet, measured RF performance, description of the test range, test plans and schedules.

3. **Satellite Operator or GVF/ATE** informs the manufacturer on the acceptability as a candidate for Type Approval and suitability of the test range and test schedule.

4. **Manufacturer** conducts Phase 1 tests (un-witnessed) and submits the results to the Satellite Operator or GVF/ATE.

5. **Satellite Operator or GVF/ATE** reviews the Phase 1 test report and informs the manufacturer on its acceptability.

6. **Manufacturer** conducts Phase 2 tests witnessed by the GVF/ATE on at least three typical production units.

7. **Manufacturer** prepares the Phase 2 Test Report, and the final report, which will include the data package signed off by the GVF/ATE, and other ancillary data (e.g. wind load performance, installation handbooks, bill of materials, antenna drawings, Quality Assurance and Control procedures, packaging and any other item requested by the Primary Operator or GVF/ATE).

8. **Satellite Operator or GVF/ATE** review the Final Report, compare the test results with the specific technical requirements, and, if applicable, Satellite Operator or the GVF will issue the relevant Type Approval Certificate.

9. If the Satellite Operator or the GVF decline to issue the type approval, the **Manufacturer** may make the necessary changes to the design and repeat partially or totally the process above.

GVF Application for Type Approval

To: ....

Applicant: .... Date: .... Ref.: ....

Company Name:..
Address: ....
....
....
Telephone: .... *E-mail*: ....

By the submission of this document, the applicant requests type approval of the following earth station antenna & equipment for operation in a space segment which is owned by one or more of the participating satellite operators.

The applicant certifies that the information provided in this application to the GVF and in the attached documents describes as close as possible the properties and performance of the Antenna/VSAT terminal concerned. Any technical modifications or manufacturing change introduced to this system in future will be reported to the GVF immediately.

In case of antenna terminals to be used for SNG purposes (manually or automatically pointed) or mobile antenna terminals (aeronautical, maritime or land mobile), the applicant shall provide together with the information 1 to 8 below, additional information as detailed in paragraphs 9, 10 and 11, as applicable.

The applicant declares his consent to have the information on this form and the subsequent test results communicated to all satellite operators participating in this project. All satellite operators will treat this information in the strictest confidence and will commit not to disclose it to third parties.

Responsible Company Officer: ....

E-mail address:…………………………………………………Telephone number……………………………………

Place: .... Date: ....

Signature/Company Stamp: ....

SECTION I – GENERAL

1. TEST FACILITIES

1.1. Planned commencement of test campaign: ……………………………………………………….
1.2. Proposed antenna test range: ……………………………………………………………………..
1.3. Number of antennas available for witnessed verification testing : ………………………..

2. PRODUCTION

2.1. Anticipated number of units to be manufactured (per year):

3. APPLICABLE STANDARDS

Please describe the standards which are currently met by your product (ITU, FCC, ETSI, etc.) and the future standards and Gain masks which the type approval is supposed to fulfill.

4. CERTIFICATION

Complete this application with the following mandatory documents:

- ❑ Full set of available radiation patterns of the system, including:
  - ❑ Tx and Rx Cuts for each axis of the antenna
  - ❑ Tx and Rx Cuts for both Azimuth and Elevation
  - ❑ Cuts for both for co-pol and cross-pol contours and each polarization sense
  - ❑ The applicable Gain masks for the antenna type
  - ❑ Indication of the beam width for 3 and 10 dB
  - ❑ Radome if applicable.
  - ❑ The origin of these data (e.g. simulation, prototype testing, etc.)
- ❑ Overview drawing and photos of complete antenna system including block diagram
- ❑ Commercial documentation/datasheets
- ❑ Screen shots of spectrum analyzer of HPA output spectrum with indication of out-of-band radiations
- ❑ 24 hours stability test records including consideration of beam pointing stability and tracking

SECTION II – ANTENNA

5. SUB-FUNCTION

☐ Drive away
☐ Fly away
☐ Suitcase antenna
☐ Vehicle mounted SNG
☐ Maritime antenna
☐ Satcom on the move
☐ Fixed
☐ Aeronautical
☐ Other (please state):

6. ANTENNA DATA

6.1. Manufacturer:
6.1.1. Model (including options):

6.1.2. f/D (focal length to diameter ratio):

6.2. If the antenna system is an integration from another system, please provide the following information:
6.2.1. Original manufacturer:

6.2.2. Original model:

6.3. Pointing system
☐ Manual
☐ Auto-deploy — Manufacturer: ....
Model & type: ....

☐ Motorized
☐ Retrofit of motors feasibility

6.4. Main reflector
☐ Circular — Diameter: ..... m
☐ Elliptical — Hor. Axis: ..... m / Ver. Axis: ... m, equivalent to … m circular
☐ Diamond — Equivalent to ………… m circular
☐ Batwing — Equivalent to ………… m circular

☐ Radome — Manufacturer: ....
Model & type: ....
Tx and Rx losses in Tx and Rx bands

☐ De-icing equipped — Manufacturer: ....
Model & type: ....

☐ Retrofit of de-icing feasibility

6.5. Tracking
☐ Monopulse
☐ Program
☐ Step
☐ Step (with memory)
☐ Conical scanning (Conscan)
☐ None
☐ Other

6.6. Type
☐ Front fed
☐ Cassegrain
☐ Gregorian
☐ Offset front fed
☐ Offset cassegrain
☐ Offset gregorian
☐ Back-fire feed
☐ Phase-array
☐ Other

6.7. Beam pointing accuracy : maximum deviation of beam……………..° at wind speed of ……………..km/h

6.8. Feed System:
6.8.1. Reference Manufacturer:

Model: ....

6.8.2. Ports ☐ Tx Nr. Ports: ……………..

☐ Rx Nr. Ports: ……………..

6.8.3. ☐ Feed blower

6.9. Polarization: ☐ Linear
☐ Circular

6.10. Frequency Bands

Rx Frequency Band (GHz)	Gain (dBi) at	Frequency (GHz)	Tx Frequency Band (GHz)	Gain (dBi) at	Frequency (Ghz)
☐ 2.20 - 2.29	………..	....	☐ 2.08 - 2.095	……	....
☐ 3.60 - 4.20	…………	....	☐ 5.80 - 6.40	……	....
☐ 7.25 - 7.75	…………	....	☐ 7.90 - 8.40	……	....
☐ 10.70-10.95	…………	....	☐ 12.75-13.00	……	....
☐ 11.20-11.70	…………	....	☐ 13.75-14.00	……	....
☐ 11.70-12.50	…………	....	☐ 14.00-14.50	……	....
☐ 12.50-12.75	…………	....	☐ 17.30-18.10	……	....
☐ 18.40-19.70	…………	....	☐ 18.10-18.40	……	....
☐ 19.70-20.20	…………	....	☐ 27.50-29.50	……	....
☐ 20.20-21.20	…………	....	☐ 29.50-30.00	……	....
☐ 21.40-22.00	…………	....	☐ 30.00-31.00	……	....

6.11. G/T: .... dB/K at .... GHz at LNA/LNB/LNC noise temperature ………………… K
At elevation angle ....degrees

6.12. Specified on-axis cross-pol isolation…………………………..dB (Tx)………….(Rx)
6.13. Specified on-axis cross-pol isolation within 1 degree………..dB (Tx)…………..(Rx)
6.14. Axial ratio (for C-Band circular)……………………………………(Tx)…………..(Rx)

6.15. Generation of **MUTE** command by (applicable to "Satcom on the Move", maritime and aeronautical systems):

☐ Not applicable
☐ Modem
☐ ACU

De-connection time …….…... seconds

7. TRANSMIT EQUIPMENT

7.1. HPA's
7.1.1. Type

☐ TWTA	Number of units: ………..	Rating (Watt): ………
☐ Klystron	Number of units: ………..	Rating (Watt): ………
☐ SSA	Number of units: …….....	Rating (Watt): ………
☐ SSPA	Number of units: ………..	Rating (Watt): ………
☐ BUC	Number of units: ………..	Rating (Watt): ………

7.1.2. Loss Post HPA loss: ………………… dB

7.1.3. Combiner ☐ Phase combiner

☐ Multiplexer
☐ Redundancy switch

7.2. Uplink EIRP
7.2.1. Maximum capability: ……. dBW

7.2.2. Overall RMS stability in the direction of the satellite: ……………. dB over 24 hours

7.2.3. Out-of-band EIRP spectral density ………………………………. dBW per 4 kHz

…………………………………. dBW per 12.5 MHz

7.2.4. Measuring equipment for transmit power: ☐ IF ☐ RF

7.2.5. EIRP measurement / adjustment:

7.3. ULPC (Up Link Power Control) mechanism controlled by:
☐ Not applicable
☐ Beacon level
☐ Sky noise temperature
☐ Operational carrier
☐ Other, please state: ………………………..

8. FREQUENCY CONVERTERS

8.1. TX frequency stability tolerance: kHz
8.2. Number of up converters:
8.3. Number of down converters:
8.4. Number of block up converters:
8.5. Number of LNA/LNB/LNC:

SECTION III – COMPONENT LIST

In order to unambiguously identify the terminal configuration, you are requested to provide, where applicable, the make and type numbers for the components listed below and complete for other essential parts as necessary:

Component	Model	Type Number
Antenna mount:	....	....
Actuator elevation	....	....
Actuator azimuth	....	....
Subreflector:	....	....
Feedhorn:	....	....
Ortho-mode transducer (OMT):	....	....
LNA/LNB/LNC:	....	....
RF-unit:	....	....
Power amplifier:	....	....
Indoor unit:	....	....
UPPC:	....	....
Antenna Control Unit (ACU)	....	....
Modem....................................	....	....
Others, please specify............	....	....
....	....	....
....	....	....

SECTION IV – SPECIAL MODELS

9. MANUAL DEPLOY TERMINAL TECHNICAL INFORMATION

If not stated already in the previous sections, this part details all the additional information which the manufacturer shall provide to GVF in conjunction with the Application form for Manual Deploy Terminal Characterization.

9.1 MANUAL-DEPLOY TERMINAL DATA SHEET

9.2 ANTENNA PARTS

- Antenna manufacturer/model,
- Feed manufacturer/model,
- OMT manufacturer/model,
- Feedboom manufacturer/model,
- Back structure manufacturer/model,
- If applicable, describe all parts which have been added to the original antenna between the OMT and the feedhorn (feed cover, waveguide adapters etc).

9.3 ANTENNA PHYSICAL CHARACTERISTICS

- Diameter (for non circular antennas major and minor axis),
- Type of geometry (Prime focus, Gregorian, cassegrain, planar…),
- Type of feed (mode matched etc),
- If mode matched feed is used describe how the feed alignment is verified,
- Reflector material (SMC, metallic, carbon fiber, glass fiber etc),
- Reflector built (petals, solid etc),
- Sub reflector material (if applicable).

9.4 ANTENNA MANUFACTURING

- Describe the manufacturing processes of the reflector(s),
- Describe the manufacturing processes of the feedhorn and OMT.

9.5 ANTENNA RF CHARACTERISTICS

- Transmit frequencies of operations,
- Receive frequencies of operations,
- Polarization (linear, circular),
- Tx and Rx Gains,
- G/T.

9.6 TERMINAL MOTION (IF APPLICABLE)

- Azimuth minimum angular manual movement resolution (degrees),
- Elevation minimum angular manual movement resolution (degrees),
- Polarization minimum angular manual movement resolution (degrees),
- Azimuth minimum slew speed (degrees/sec),
- Elevation minimum slew speed (degrees/sec),
- Polarization minimum rotational speed (degrees/sec),
- Resolvers manufacturer, model and type (optical, etc),
- Resolvers resolution (number of bits). Example for a 360° Azimuth slew, 16 bits would yield a resolution of 360/2E16= 0.005°,
- Fine pointing description (if no motorization is available)

- The expected operational and survival wind conditions and the methods which have been used to prove them (e.g. wind load tests and analysis),
- Temperature and humidity operational conditions
- Terminal expected backlash,
- Maximum operating tilt of the antenna,

9.7 TRANSMITTER

- Manufacturer/model and number,
- Type of transmitters (TWTA, SSPA, BUC, etc),
- Transmitter rating,
- Post HPA losses.

9.8 MODEM(S)

- Manufacturer/model.

9.9 MONITORING SYSTEMS

- Transmit RF Carrier monitoring system (type, manufacturer, model),
- Transmit coupling factor,
- Post-coupler loss,
- Demodulator (type, manufacturer, model).

9.10 MOTOR (IF APPLICABLE)

- Calibration method and required calibration schedule

9.11 INSTALLATION AND OPERATIONS HANDBOOK

10. AUTO-DEPLOY TERMINAL TECHNICAL INFORMATION

This point details the information which the manufacturer shall provide to GVF in conjunction with the Application form for Auto-Deploy and Pointing Terminal Characterization, if not stated in paragraph 1 through 7 above.

10.1 AUTO-DEPLOY TERMINAL DATA SHEET

ANTENNA PARTS

- Antenna manufacturer/model,
- Feed manufacturer/model,
- OMT manufacturer/model,
- Feedboom manufacturer/model,
- Back structure manufacturer/model,
- If applicable describe all parts which have been added to the original antenna between the OMT and the feedhorn (feed cover, waveguide adapters etc).

10.2 ANTENNA PHYSICAL CHARACTERISTICS

- Diameter (for non circular antennas major and minor axis),
- Type of geometry (Prime focus, Gregorian, cassegrain, planar…),
- Type of feed (mode matched etc),
- If mode matched feed is used describe how the feed alignment is verified,
- Reflector material (SMC, metallic, carbon fibre, glass fibre etc),
- Reflector built (petals, solid etc),
- Sub reflector material (if applicable),

10.3 ANTENNA MANUFACTURING

- Describe the manufacturing processes of the reflector(s),
- Describe the manufacturing processes of the feedhorn and OMT.

10.4 ANTENNA RF CHARACTERISTICS

- Transmit frequencies of operations,
- Receive frequencies of operations,
- Polarization (linear, circular),
- Tx and Rx Gains,
- G/T.

10.5 AUTO-DEPLOY TERMINAL INTEGRATION

- System integrator,
- Model,
- Describe the inspections and measurements on reception of every auto-deploy terminal subcomponents: reflector, sub reflector if applicable, feed horn, OMT, back structure, struts, cover, motors, encoders, GPS, compass etc.,
- Describe the changes to the mount which have been implemented,
- Describe how the original antenna is integrated with the motors and the hosting platform,

- Provide the expected distances between predetermined points on the feed, reflector and sub reflector (if applicable) and the accepted tolerances,
- Describe the verifications performed on the antenna geometry to ensure that the original optics is maintained and expected tolerances,
- Describe the auto-deploy terminal commissioning,
- Describe the search mechanism to obtain carrier/pilot lock
- Quality control and assurance processes,
- Total weight of the auto-deploy terminal.

10.6 AUTO-DEPLOY TERMINAL SUB-SYSTEMS

- ACU manufacturer and model,
- Positioner manufacturer and model,
- Auto-deploy terminal's controller manufacturer and model,
- Auto-deploy controller software vendor, designation and version number,
- Location of the auto-deploy routine,
- Motors' manufacturer, model, type and number of them.

10.7 AUTO-DEPLOY TERMINAL MOTION

- Azimuth minimum angular manual movement resolution (degrees),
- Elevation minimum angular manual movement resolution (degrees),
- Polarization minimum angular manual movement resolution (degrees),
- Azimuth minimum slew speed (degrees/sec),
- Elevation minimum slew speed (degrees/sec),
- Polarization minimum rotational speed (degrees/sec),
- Resolvers manufacturer, model and type (optical, etc),
- Resolvers resolution (number of bits). Example for a 360° Azimuth slew, 16 bits would yield a resolution of 360/2E16= 0.005°,
- The minimum step for the step-by-step slew should be 0.1°or smaller to ensure the correct evaluation of the pointing error,
- The expected operational and survival wind conditions and the methods which have been used to prove them (e.g. wind load tests and analysis),
- Temperature and humidity operational conditions
- Auto-deploy terminal expected backlash,
- Maximum operating tilt of the antenna,

10.8 AUTO-DEPLOY OPERATIONS AND PROCEDURES

- Describe the pointing algorithms used (beacon reception, DVB-S reception, dedicated signal from a Hub, NORAD parameters, etc),
- Describe the polarization alignment method (calculation, cross-polarization nulling etc). It applies for linear polarized antennas only,
- Expected pointing accuracy (Azimuth, Elevation, Polarization (linear polarization only) in degrees),
- Satellite pointing process (describe),
- Satellite peaking process (describe),
- Polarization alignment and optimisation method (describe). It applies for linear polarized antennas only,
- The angle of the polarization plane of the satellites with respect to the equatorial plane (skew angle) needs to be taken into account whenever the polarization alignment of the antenna is optimised by calculation. Describe satellite skew look up tables, see Annex 1. It applies for linear polarized antennas only,

- Transmission enable procedures (describe)
- Please declare that the integrated software which regulates system transmission control is not to be accessed and modified by a third party.

10.9 TRANSMITTER

- Manufacturer/model and number, please provide a list of all compatible units.
- Type of transmitters (TWTA, SSPA etc),
- Transmitter rating,
- Post HPA losses.
- Is it possible to limit the input power of the system? If so, describe the process.
- Is it possible to limit the output power of the system? If so, describe the process
- Is it possible to attach a transmitter to the system which is considerably higher in specified power than your antenna system was designed for?

10.10 MODEM(S)

- Manufacturer/model, please provide a list of all compatible units.

10.11 MONITORING SYSTEMS

- Transmit RF Carrier monitoring system (type, manufacturer, model),
- Transmit coupling factor,
- Post-coupler loss,
- Demodulator (type, manufacturer, model).

10.12 MOTOR

- Calibration method and required calibration schedule

10.13 OTHER PARTS

- Cover/radome manufacturer/model,
- Jacks manufacturers/model, number and position,
- GPS manufacturer/model,
- Compass(es) manufacturer/model,
- Vehicle manufacturer/model (drive away),
- Transportation case(s) and mount manufacturer/model (fly away).

10.14 INSTALLATION AND OPERATIONS HANDBOOK

11. MOBILE ANTENNA TESTS

For the specific case of antennas for the aeronautical, maritime and land mobile, additional tests on the tracking system will be performed to assess the Beam Pointing Error (BPE).

Test facilities to assess the BPE shall be made available by the applicant in order to simulate movements on the 3 axis, at predetermined speeds and accelerations.

The maximum acceptable BPE is normally set to ± 0.2°.

Additional tests shall be performed to prove the ability of the terminal to cease transmission (mute) when the BPE exceeds a target value and the ability to resume transmission when the BPE falls below a target value..

The applicant shall provide also a block diagram showing how the mute function is implemented (e.g. muting directly the transmitter or through the modem?)

12. ANNEX 1 EIRP SPECTRAL DENSITIES

12.1. Co-pol Off-Axis EIRP Spectral Density (EIRPSD) Mask

The following specifications apply:

Specification	Summary* (normalized to dBW/40 kHz, N = 1)	Start angle*
FCC 47 CFR 25.218 (8^{th} order); FCC 47CFR25.209 & 212 (pattern/power); FCC 47CFR25.222 (ESV)	25 – 25 log(θ)	1.5° 1.25° 1.25°
Eutelsat Standard M	31 – 25 log(θ)	1.0 - 2.0°
UK OFCOM Licensing Procedures Manual For Satellite (Network Earth Station) Applications. Schedule 1, sec 4 f).	20	2.5°
ITU-R S.728-1 (Ku-band VSAT)	33 – 25 log(θ)	2.0°
ETSI EN 301 428, 4.2.3.2 (V1-2-7)	33 – 25 log(θ)	2.5°
ITU-R S.524-9 for Ku-band; UK OFCOM; ETSI TS 101 136	39 – 25 log(θ)	2.5°
Anatel Resolutions 364 (C, Ku) and 288 (Ku)	TBD	TBD

* Summary information is for reference only.

12.2. Cross-pol Discrimination (XPD)

Specification	XPD summary*
ITU-R S.727	25 dB within 0.3 dB** contour of the main lobe. 20 dB within 20 dB contour
Intelsat Std G, Std K	26 dB
ETSI TS 101 136 Class C30	30 dB
ETSI TS 101 136 Class C35; Eutelsat Standard M	35 dB 25 dB within -1 dB contour of the main lobe**

* Summary information is for reference only. Additional specification TBD

**For broad beam antennas (e.g. C-band) angles may be considered instead of dB.

In case of auto-deploy or mobile terminals, the specifications above shall be met at its maximum Beam Pointing Error (BPE). BPE should include wind loading deflection and backlash.

12.3. Off-axis EIRP Spectral Density Regulations

The provisions of ITU-R S.542-9 (or the most current version thereof) shall set the maximum permissible off-axis EIRP limits. Regional or national limits may modify the provisions of ITU-R S.542.9 providing that they do not exceed the recommended EIRP limits in any direction. The radiation pattern characteristics of all auto-deploy and VMES antenna systems are expected to comply with the most current requirements of ITU-R S.580 or those in force for a particular geographic or national region providing that the EIRP density does not exceed the limits of ITU-R S.580. Terminals failing to meet the requirements of ITU-R S.580 (or those of local regulatory limitations) may be authorized by limiting the input power to the terminal such that its up-link EIRP density does not exceed the limits of ITU-R S.524 (or local regulatory limit) in any direction.

12.4. Notes and excerpts from ITU-R S.524-9 for Ku-Band FSS Operation

Operation in this band shall be confined to the 12.**75** – 13.25 GHz for the satellite to earth path and 13.75 – 14.50 GHz for earth to satellite link.

Certain satellite operators require different satellite to earth path frequency ranges ((i.e. for Eutelsat: 11.7 -12.75 GHz; Star One: 10.9-12.2 GHz)

The uplink EIPR shall be restricted such EIRP density in any direction along the GSO does not exceed the following values.

Angular Range	Maximum EIRP per 40 kHz
2.5 <= θ <= 7.0 deg	39 – 25 log (θ) dBW / 40 kHz
7.0 < θ <= 9.2 deg	18 dBW / 40 kHz
9.2 < θ <= 48 deg	42 – 25 log (θ) dBW / 40 kHz
48 < θ <= 180 deg	0 dBW / 40 kHz

12.5. Notes and excerpts from FCC regulations

Until recently the FCC did not establish an off-axis EIRP mask in the same way as specified by the provisions of ITU-R S.524. Rather the FCC set limits on the input power to the antenna flange and the off-axis radiation characteristics for the antenna under consideration. The combination of these two requirements effectively set the off-axis EIRP radiation levels. Recently FCC Eight Order resulted on a new ruling 47 CFR 25.218 which combined the provisions of 47 CFR 25.212 and 47 CFR 25.209 to establish an off-axis EIRP mask which extended from 1.5 degrees to 7 degrees. Thus the key provisions of FCC requirements for narrow Ku-band transmissions can be summarized by the following:

12.6. FCC sidelobe mask (47 CFR 25.209)

The antenna gain for a compliant antenna shall not exceed the following limits over the defined angular limits

Angular Range	Maximum gain
1.0 deg <= (θ) <= 7.0 deg	29 – 25 log (θ) dBi
7.0 deg <= (θ) <= 9.2 deg	+ 8 dBi
9.2 deg <= (θ) <= 48.0 deg	32 – 25 log (θ) dBi
48. deg <= (θ) <= 180. deg	- 10 dBi

The close in sidelobe mask for small antennas (1.2 meters) is increased to start at 1.25 degrees than 1.0 degrees.

12.7. Input power limitations, Narrowband Ku-band transmissions (46 C.F.R. 25.212)

The power density presented to the antenna input flange shall not exceed -14 dBW / 4 kHz for narrow band transmissions. This equates to -4 dBW / 40 kHz when comparing with the ITU bandwidth designations.

12.8. FCC New Eighth Report and Order (47 C.F.R. 25.218)

This rule expanded the starting angle for the initial 29 – 25 log (θ) mask to 1.5 degrees. The rule also set the EIRP density limit over the angular range from 1.5 deg <= (θ) <= 7 deg to a maximum EIRP of 15 – 25 log(θ) dBW / 4 kHz. This equates to an EIRP density of 25 – 25 log(θ) dBW / 40 kHz when comparing with the ITU bandwidth designations.

If antenna does not meet 29-25 log(θ) then power density at the antenna flange shall be reduced such that the radiated EIRP complies with the 15-25 log(θ) dBw/4kHz limit from 1.5deg < θ > 7deg.

12.9. FCC ESV regulation (47 C.F.R. 25.222)

This rule was created for Ku-band VSATs on ships (vessels) using stabilized antennas. It essentially follows the combination of 25.209 (antenna pattern) with 25.212 (transmitter power spectral density) to give a net off-axis EIRP spectral density mask of 15 – 25log(θ) dBW per 4 kHz, starting at 1.25 degrees. It also requires that the antenna have a maximum pointing error of 0.2 degrees, cease transmission within 100 ms if the pointing error exceeds 0.5 degrees, and not resume transmission until the error returns to less than 0.2 degrees.

12.10. Notes on UK OFCOM regulations

The U.K. Office of Communications has utilized the ITU requirements to set limits for the antenna radiation pattern coverage and off-axis EIRP limits. The antenna radiation pattern is required to comply with the provisions of ITU-R 465 or ITU-R S.580 for antennas installed after 1995. The off-axis EIRP power density mask is required to comply with the provisions of ITU-R S.524-9.

Mobile stations shall employ a stabilized platform with the ability to maintain a pointing accuracy +/-0.2 degrees towards the relevant Geostationary Satellite through transmissions. In addition, the maximum EIRP at angles greater than or equal to 2.5 degrees from the antenna main beam axis shall not exceed 20 dBW/40 KHz from any individual station.

13. ANNEX 2 GAIN MASKS OF INTELSAT AND EUTELSAT

13.1. Transmit Sidelobes Mandatory requirements for Intelsat

$D/\lambda < 50$

$G = 32 - 25 \log \theta$	dBi	$100\lambda/D^\circ \leq \theta \leq 48^\circ$
$G = -10$	dBi	$\theta > 48^\circ$

$D/\lambda \geq 50$

$G = 29 - 25 \log \theta$	dBi	$1^{\circ *} \leq \theta \leq 20^\circ$
$G = -3.5$	dBi	$20^\circ < \theta \leq 26.3^\circ$
$G = 32 - 25 \log \theta$	dBi	$26.3^\circ < \theta \leq 48^\circ$
$G = -10$	dBi	$\theta > 48^\circ$

This requirement shall be met within any frequency in any direction within 3° of the geostationary arc.

*For D/λ below 100, this angle becomes 100 λ/D

13.2. Transmit Sidelobes Mandatory Requirements for Eutelsat

$D/\lambda > 30$

$G = 29 - 25 \log \theta$	dBi	$\alpha^{\circ *} < \theta \leq 7^\circ$
$G = +8$	dBi	$7^\circ < \theta \leq 9.2^\circ$
$G = 32 - 25 \log \theta$	dBi	$9.2^\circ < \theta \leq 48^\circ$
$G = -10$	dBi	$\theta > 48^\circ$

$D/\lambda \leq 30$

$G = 32 - 25 \log \theta$	dBi	$\alpha^{\circ *} < \theta \leq 48^\circ$
$G = -10$	dBi	$\theta > 48^\circ$

This requirement shall be met over the full extent of the antenna transmit frequency bands and within any direction towards the geostationary satellite orbit and within the bounds between 3° North and 3° South of the geostationary satellite orbit (as seen from the centre of the earth).

*$\alpha = 1^\circ$ or $(100\lambda/D)$ whichever is greater.