

June 12, 2014

BY ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

Re: *Submission of Measured Transmitting Antenna Off-Axis Gain Information for DIRECTV RB-2 (Call Sign S2712)*

Dear Ms. Dortch:

Pursuant to Section 25.264 of the Commission's rules and the *17/24 GHz BSS Second R&O*,¹ DIRECTV Enterprises, LLC ("DIRECTV") hereby submits the measured transmitting antenna off-axis gain information and associated power flux-density ("PFD") calculations for DIRECTV RB-2, a geostationary satellite in the 17/24 GHz Broadcasting Satellite Service ("BSS") authorized to operate at the nominal 103° W.L. orbital location.²

As required under Section 25.264(a), DIRECTV previously submitted the predicted transmitting antenna off-axis gain information for DIRECTV-RB2.³ Section 25.264(c) provides that each 17/24 GHz BSS space station licensee must submit measured transmitting antenna off-axis gain information over the same angular ranges, measurement frequencies, and polarizations described in Section 25.264(a). Those requirements are as follows:

- (1) in the X-Z plane, *i.e.*, the plane of the geostationary orbit, over a range of ± 30 degrees from the positive and negative X axes in increments of 5 degrees or less;

¹ *Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band*, 26 FCC Rcd. 8927 (2011) ("*17/24 GHz BSS Second R&O*").

² *See DIRECTV Enterprises, LLC*, 24 FCC Rcd. 9393 (Int'l Bur. 2009).

³ *See Stamp Grant*, IBFS File No. SAT-MOD-20111128-00229 (granted May 24, 2012).

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- (2) in planes rotated from the X-Z plane about the Z axis, over a range of ± 60 degrees relative to the equatorial plane, in increments of 10 degrees or less;
- (3) in both polarizations;
- (4) at a minimum of three measurement frequencies determined with respect to the entire portion of the 17.3-17.8 GHz frequency band over which the space station is designed to transmit: 5 MHz above the lower edge of the band; at the band center frequency; and 5 MHz below the upper edge of the band; and
- (5) over a greater angular measurement range, if necessary, to account for any planned spacecraft orientation bias or change in operating orientation relative to the reference coordinate system. The applicant must also explain its reasons for doing so.

This information is to be measured under conditions as close to flight configuration as possible, though the Commission has specifically recognized that this exercise may be conducted with “the use of simulated spacecraft components.”⁴

In the Technical Appendix accompanying this submission,⁵ DIRECTV submits both simulated and measured data for DIRECTV RB-2.⁶ The measured data was obtained by the satellite manufacturer, Astrium SAS, on a Compact Antenna Test Range (“CATR”) using the actual transmit antenna for the DIRECTV RB-2 satellite. That antenna had not yet been integrated with the spacecraft. Thus, for purposes of these measurements, the antenna was combined with a detailed mock-up of the spacecraft body to represent those elements of the actual spacecraft structure that could potentially play a role in influencing the far off-axis gain performance. The entire test configuration was surrounded (to the extent feasible) with material designed to absorb radio frequency energy. Slide 5 in the attached data set provides a photo of the set-up.

As explained in the Technical Appendix, due to mechanical restrictions, it was not possible to obtain measured results over the entire range called for in Section 25.264. Note that predicted results are provided for the entire range and that the measured results were overlaid with the simulated predictions over the achievable measurement range. A review of

⁴ See 47 C.F.R. § 25.264(a); *17/24 GHz BSS Second R&O*, ¶ 50.

⁵ Please note that due to the size of the data package included in the Technical Appendix (*i.e.*, > 73 MB), this data is being submitted separately on a CD. We request that you associate this information with this letter in the Commission’s electronic database.

⁶ Since DIRECTV does not plan any orientation bias or change in operating orientation relative to the reference coordinate system for this spacecraft, it has provided data only over the range called for in the rule. See 47 C.F.R. § 25.264(a)(5).

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these overlaid results shows that there is very good correlation between the predicted and measured results. As such, there is every reason to believe that the simulated results over the entire range represent a good estimate of the actual far off-axis gain across the entire range.

In addition, Section 25.264(d) provides that a 17/24 GHz BSS licensee must provide PFD calculations based upon the measured transmitting antenna off-axis gain information. DIRECTV RB-2 will transmit signals in the 17 GHz band in three separate beams, *i.e.*, a CONUS+Alaska beam, a Hawaii spot beam, and a Puerto Rico spot beam. The peak EIRP, peak EIRP density, and minimum far-off-axis gain discrimination for each of these beams is shown in Table 1 below.

Beam	Peak EIRP (dBW)	Peak EIRP density (dBW/Hz)	Tx isolation (dB)
CONUS+AK	58.9	-16.7	44.2
HAWAII	57.5	-18.1	52.2
PUERTO RICO	60.6	-15.0	58.7

Table 1. Peak EIRP, EIRP Density, and Minimum Far Off-Axis Discrimination for Each DIRECTV RB-2 17 GHz Transmit Beam

As demonstrated in Table 2 below, based on the data provided, the satellite will not exceed the $-117 \text{ dBW/m}^2/100 \text{ kHz}$ PFD coordination trigger with respect to any DBS satellite located more than 0.08° away. DIRECTV RB-2 is currently licensed to operate at 102.825° W.L., and has recently requested a slight relocation to 102.75° W.L.⁷ Given that the nearest prior-filed or subsequently-filed U.S. DBS space station is DIRECTV 4S, located at 101.2° W.L. (*i.e.*, almost 1.5° away, net of station keeping allowances), the spacecraft will not trigger the PFD threshold at any relevant location.

⁷ See IBFS File No. SAT-MOD-20140612-00066 (filed June 12, 2014).

DIRECTV RB-2	CONUS+AK	Hawaii	Puerto Rico
Max EIRP from Sched S (dBW/36 MHz)	58.9	57.5	60.6
Peak Tx antenna gain (dBi)	36.2	48.2	48.7
Max power into antenna (dBW/36 MHz)	22.7	9.3	11.9
Max power density into antenna (dBW/100 kHz)	-2.9	-16.3	-13.7
Max off-axis predicted antenna gain (dBi)	-8	-4	-10
Max off-axis EIRP density (dBW/100 kHz)	-10.9	-20.3	-23.7
Coordination trigger value (dBW/m ² /MHz)	-117	-117	-117
Req'd spreading loss to meet coord trigger (dB-m ²)	106.1	96.7	93.3
Req'd distance to achieve spreading loss (km)	57.2	19.4	13.1
Geocentric orbital separation equal to req'd separation distance (deg)	0.08	0.03	0.02

Table 2. Orbital Separation Required to Meet Coordination Trigger

As explained above, due to mechanical/physical limitations of the test fixture, measurements could only be made over a range of ± 25 degrees relative to the equatorial plane in planes rotated from the X-Z plane about the Z axis. Accordingly, in an abundance of caution, DIRECTV has included below a request for a waiver to the extent necessary.

WAIVER REQUEST

Section 25.264(a)(2) of the Commission’s rules, as incorporated by Section 25.264(c), specifies that transmitting off-axis gain measurements should be made “in planes rotated from the X-Z plane about the Z axis, over a range of ± 60 degrees relative to the equatorial plane, in increments of 10 degrees or less.” Due to mechanical/physical limitations of the test fixture, measurements could only be made over a range of ± 25 degrees relative to the equatorial plane in planes rotated from the X-Z plane about the Z axis.

To the extent necessary, DIRECTV hereby requests a waiver of this requirement. Granting the requested waiver would be consistent with Commission policy.

The Commission may waive a rule for good cause shown. Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule. Generally, the Commission may grant a waiver of its rules in a particular case if the relief requested would not undermine the

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policy objective of the rule in question and would otherwise serve the public interest.⁸

The criteria justifying a waiver are clearly present in this case. The measurements submitted by DIRECTV were made over the greatest angular extent physically possible with the test fixture using the actual transmit antenna integrated with a detailed mock-up of the spacecraft components that could impact the measurement. These measurements cover a large portion of the angular range specified in the Commission's rules. While there was some variation in the absolute level of off-axis gain across the 0° to 25° angular range that was measured, all measured levels of off-axis gain were very low, and measured results correlated very well with predicted results. As such, there is every reason to expect that if measurements were possible for the entire range, the results of those measurements would correlate very well with the simulated results for the entire range.

Accordingly, grant of the requested waiver would not undermine the policy objective of the rule in either case, and would serve the public interest by enabling DIRECTV to proceed with construction without the considerable expense and program delay that would be associated with devising a new measurement setup capable of taking measurements at a greater angular range.

For the foregoing reasons, DIRECTV requests that it be granted a waiver of Section 25.264(c) of the Commission's rules to the extent necessary.

* * *

Should you have any questions about this submission, please do not hesitate to contact me.

Respectfully submitted,

/s/

William M. Wiltshire
Counsel for DIRECTV

Attachments

⁸ *PanAmSat Licensee Corp.*, 17 FCC Rcd. 10483, ¶ 22 (Int'l Bur. 2002) (footnotes omitted).

ENGINEERING CERTIFICATION

The undersigned hereby certifies to the Federal Communications Commission as follows:

- (i) I am the technically qualified person responsible for the engineering information contained in the foregoing submission,
- (ii) I am familiar with Part 25 of the Commission's Rules, and
- (iii) I have either prepared or reviewed the engineering information contained in the foregoing submission, and it is complete and accurate to the best of my knowledge and belief.

Signed:

/s/

Jack Wengryniuk

June 12, 2014

Date

TECHNICAL APPENDIX

[Submitted via CD]