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INTELSAT EARTH STATION STANDARDS (IESS)
Document IESS-315

PERFORMANCE CHARACTERISTICS FOR
VSAT SERVICE USING TURBO CODING
WITH QPSK / OQPSK MODULATION

(Intelsat IX, Standard E-1, F-1, H and K VSAT Earth Stations)

(New Module)

Approval Date:

10 March 2005

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INTELSAT EARTH STATION STANDARDS (IESS)PERFORMANCE CHARACTERISTICS FOR VSAT SERVICE
USING TURBO CODING WITH QPSK / OQPSK MODULATION

(Intelsat IX, Standard E-1, F-1, H and K VSAT Earth Stations)

1. INTRODUCTION

This document defines the performance characteristics for Intelsat's Very Small Aperture Terminal (VSAT) services on Intelsat IX spacecraft using turbo coding in conjunction with QPSK / Offset QPSK (OQPSK) modulation. VSAT earth stations will typically operate in a Star network configuration by transmitting to and receiving from larger hub earth stations (Standards A, B, C, F-3, F-2, E-3 or E-2). Mesh network configurations involving transmissions between or among VSAT earth stations may also be permitted, based on a case-by-case analysis by Intelsat.

It is the user's responsibility to ensure that compatible turbo modems (modulators/demodulators) are employed at both ends of the satellite link.

1.1 IESS Notations

For clarity, characteristics that are mandatory requirements have been marked by a thick line in the left-hand margin, as illustrated for this paragraph.

2. APPLICABLE EARTH STATION STANDARDS

The Intelsat VSAT service is defined for digital carriers that either terminate at or originate from Intelsat Standards F-1, H, E-1 and K earth stations accessing direct C-to-C and Ku-to-Ku capacity on Intelsat IX spacecraft. VSAT service is not offered currently on Intelsat IX cross-strapped C-to-Ku and Ku-to-C transponder connectivities but will be considered by Intelsat on a case-by-case basis.

The IESS modules that are applicable to this module are IESS-207 (Standards A, B, F and H) and IESS-208 (Standards C, E and K). IESS-207 and IESS-208 and their corresponding Satellite Systems Operations Guide (SSOG) modules, SSOG-207 and SSOG-208, may be downloaded, free of charge, in Adobe Acrobat's Portable Document Format (PDF) from Intelsat's web site (http://www.intelsat.com/tech/techsrch_e.asp).

2.1 Additional G/T Requirement

Within a given beam coverage area, the downlink degradation* due to the local rain statistics at a particular VSAT earth station site may be larger than the maximum downlink margin provided by Intelsat for Ku-Band operation. Users operating with such VSAT earth stations will need to provide improved RF performance in the form of a VSAT earth station G/T that exceeds the minimum required.

The additional G/T which may be required for operation under degraded weather conditions is determined by computing the downlink degradation based on the local yearly rain statistics and comparing them against the maximum downlink margin given in Table 1. If the local rainfall statistics indicate that the downlink degradation will exceed this value, then the required G/T of that earth station shall be determined by the following equations:

$$\text{Standard E-1: } G/T \geq 25.0 + 20 \log 10 f / 11.0 + X \text{ dB, dB/K}$$

$$\text{Standard K-3: } G/T \geq 23.3 + 20 \log 10 f / 11.0 + X \text{ dB, dB/K}$$

$$\text{Standard K-2: } G/T \geq 19.8 + 20 \log 10 f / 11.0 + X \text{ dB, dB/K}$$

Where:

G = receiving antenna gain (relative to an isotropic radiator) referred to the input of the low-noise amplifier (LNA);

T = receiving system noise temperature (relative to 1 Kelvin) referred to the input of the low-noise amplifier (LNA);

f = receive frequency in GHz; and

X = the amount by which the downlink degradation predicted by local rain statistics exceeds the reference downlink margin shown in Table 1. An Excel spreadsheet (X-FACTOR.XLS) for calculating this X factor is available for downloading from Intelsat's public web site at http://www.intelsat.com/iess/iess_e.asp#iessfiles.

3. VSAT CARRIER CHARACTERISTICS

The characteristics and system assumptions pertaining to Intelsat's VSAT service using turbo coding in conjunction with QPSK / OQPSK modulation are summarized in Table 1.

* Downlink degradation is defined as the sum of the precipitation attenuation (in dB) and the increase in the receiving system noise temperature (in dB) for the given percentage of time.

3.1 Applicable Satellite

VSAT service is currently offered only on Intelsat IX satellites for all beam connections, except cross-strapped C-to-Ku and Ku-to-C Band transponder connectivities. Service on Intelsat IX cross-strapped transponders will be considered, however, on a case-by-case basis by Intelsat.

3.2 Transmission Parameters

Information rates ranging from 64 kbit/s up to 8.448 Mbit/s are supported, subject to the requirements of Section 3.3. Lower rates are available to the user (i.e., 300, 600 bit/s, 1.2, 2.4, 4.8, 9.6, 48 and 56 kbit/s) but these must be multiplexed to form at least a 64 kbit/s carrier prior to transmission to the satellite.

Transmission parameters for VSAT carriers are given in Appendix B for Rate 1/2 (Table B.1), Rate 3/4 (Table B.2) and Rate 7/8 (Table B.3) turbo coding with QPSK or Offset QPSK (OQPSK) modulation. The code rate actually employed on any given link will, however, be determined at the sole discretion of Intelsat for the purposes of optimizing the utilization of the space segment.

3.3 Connectivity Considerations for VSATs

The off-axis emission density radiated by an earth station is constrained by Recommendation ITU-R S.524-7. These constraints limit the allowable connectivities between VSAT antennas. To assist users in the planning of their VSAT earth stations, connectivity matrices showing the off-axis emission indicators* for Intelsat IX are provided in APPENDIX C. The earth station-to-earth station off-axis emission indicators provided in APPENDIX C assume the earth station sidelobe radiation patterns described in IESS-207 and IESS-208. The connectivity constraints identified in APPENDIX C can be relaxed if VSATs have certain geographical advantage and/or can demonstrate that their sidelobe radiation patterns are better than those described in IESS-207 and IESS-208.

4. EARTH STATION IF AND RF REQUIREMENTS

4.1 Modulator Spectrum Output

The transmitted IF spectrum at the output of the modulator shall meet the power spectral density mask shown in Figure 2.

4.2 Energy Dispersal (Scrambling)

In order to reduce the maximum power flux density in accordance with Rec. ITU-R SF.358-5 and to meet the off-axis EIRP density criteria in accordance

* The off-axis emission indicators indicate the amount by which the transmit earth station emission conforms with (positive margin) or exceeds (negative margin) the requirements of Rec. ITU-R S.524-7.

with Rec. ITU-R S.524-7, scrambling shall be applied. To accomplish this, a data scrambler shall be employed at the transmit earth station. The scrambler shall have a logic diagram equivalent to that shown in Figure 3, and the descrambler shall have the impulse response shown in Figure 4.

4.3 Earth Station EIRP and Pattern Advantage

The nominal earth station EIRP values provided in APPENDIX D were derived based on the assumptions that: (a) earth stations have an elevation look angle of 10° and, (b) are located away from the edge of the satellite antenna beam coverage (i.e., benefit from having a beam pattern advantage). For C-Band links, an uplink / downlink pattern advantage of 2 dB / 2 dB was assumed; for Ku-Band links, 3 dB / 3 dB was assumed. To determine the proper sizing for their earth station HPA, users will need to perform link budget calculations taking into consideration the specific characteristics of their link.

4.4 EIRP Stability

The EIRP in the direction of the satellite shall, except under adverse weather conditions, be maintained to within ± 1.5 dB for Standards E, F, H and K.

This tolerance includes all earth station factors contributing to EIRP variation, e.g., HPA output power level instability, antenna beam pointing and/or tracking error, added on a root-sum-square basis.

5. EMISSION CONSTRAINTS

5.1 Off-Axis Emission Constraint

The maximum EIRP radiated by VSAT earth stations shall be constrained by the off-axis emission density limits of Recommendation ITU-R S.524-7 [see Table D.1 (Rate 1/2 turbo QPSK / OQPSK), Table D.2 (Rate 3/4 turbo QPSK / OQPSK) or Table D.3 (Rate 7/8 turbo QPSK / OQPSK)].

5.2 Spurious Emissions Within The Satellite Band (5.850 to 6.425 GHz and 14.0 to 14.50 GHz)

5.2.1 Spurious Emissions — Non-Intermodulation Products

The following frequency ranges apply for all specifications in this section:

<u>Operating Satellite</u>	<u>Frequency Range</u>	
Intelsat IX	5,850 to 14,000 to	6,425 MHz 14,500 MHz

5.2.1.1 VSAT Carrier Not Activated (“Off”)

The EIRP resulting from spurious tones, bands of noise or other undesirable products, but excluding multicarrier intermodulation products and spectral spreading due to earth station nonlinearities, that are present when the VSAT carriers are not activated (carrier “off”) shall not exceed -30 dBW / 4 kHz (provisional) anywhere within the specified frequency ranges from VSAT Standard E–1, F–1, H and K VSAT earth stations and 4 dBW / 4 kHz from the larger hub earth stations.

5.2.1.2 VSAT Carrier Activated (“On”)

Spurious products, excluding the multicarrier intermodulation products and spectral spreading due to earth station nonlinearities, that are generated whenever VSAT carriers are activated (carrier “on”) and which lie within the specified frequency ranges, shall be at least 50 dB below the level of an unmodulated carrier (i.e., -50 dBc) for carriers having information rates up to and including 8.448 Mbit/s.

5.2.2 Spurious Emissions – Intermodulation Products

The mandatory EIRP limits for intermodulation products resulting from multicarrier operation of the earth station wideband RF equipment are addressed in module IESS–401.

5.2.3 RF Out-of-Band Emission (Carrier Spectral Sidelobes)

To limit interference into adjacent carriers, the EIRP density outside of the satellite bandwidth allocated for each VSAT carrier, resulting from spectral regrowth due to earth station nonlinearities measured in a 4 kHz band, shall be at least 26 dB below the main carrier spectral density when transmitted from a Standard A, B, C, E–3, E–2, F–3 or F–2 earth station and at least 23 dB below the main carrier spectral density for transmissions from a Standard E–1, F–1, H or K earth station.

The above limits apply only to the spectral sidelobes that may experience regrowth due to earth station nonlinearities. The EIRP density in the frequency range from $0.7R_s$ to R_s Hz away from the nominal center frequency shall be at least 16 dB below the peak EIRP density, measured in a 4 kHz band, where R_s is the symbol rate in symbols per second.

5.3 Unwanted Emissions Outside The Satellite Band

The definition of unwanted emissions (out-of-band and spurious) from both earth stations and spacecraft operating in the Fixed Satellite Service (FSS) are defined in Chapter 1 of the Radio Regulations, Nos. 1.144 and 1.145, respectively.

The out-of-band (OOB) domain comprises the region extending from the edge of the earth station amplifier’s passband to the boundary between the OOB

domain and the spurious domain. This boundary is normally located at a frequency offset from the edge of earth station high power amplifier's passband that is equal to twice the amplifier's bandwidth. The spurious emissions domain extends from the boundary with the OOB domain outwards. (Refer to Recommendations ITU-R SM.329-9, SM.1539 and SM.1541.)

Users should note that national regulators may impose additional domestic constraints on earth stations beyond those listed in this section. Users should, therefore, consult with their domestic regulatory authority to determine if such limits exist and to comply with them.

5.3.1 Out-Of-Band (OOB) Emissions

The Radio Regulations provide some general guidance on the need to limit OOB emissions to protect those services operating in the adjacent frequency bands (see RR No. 4.5).

The level of undesirable emissions in the out-of-band (OOB) domain should conform with the requirements of Annex 5 of ITU-R Recommendation SM.1541.

5.3.2 Spurious Emissions in the Spurious Domain – For Earth Stations Brought Into Service After 1 January 2003

All earth stations brought into service after 1 January 2003 shall ensure that spurious emissions in the spurious domain meet the mandatory requirements of Section 2 of Appendix 3 of the Radio Regulations.

5.3.3 Spurious Emissions in the Spurious Domain – For All Earth Stations After 1 January 2012

After 1 January 2012, all earth stations shall meet the mandatory requirement of Section 2 of Appendix 3 of the Radio Regulations.

5.4 Frequency Tolerance and Spectrum Inversion

5.4.1 Carrier RF Frequency Tolerance

The RF frequency tolerance (maximum uncertainty of initial frequency adjustment plus long-term drift) on all VSAT carriers shall be $\pm 0.025 R$ up to a maximum of 3.5 kHz, where R is the transmission rate in bits per second. Long term is assumed to be at least one month.

The earth station's receive chain frequency stability should be consistent with the frequency acquisition and tracking capabilities of the demodulator but, as a minimum, it is recommended that it be no greater than ± 3.5 kHz.

5.4.2 Satellite Transponder Frequency Tolerance

The translation frequency tolerance due to the satellite should be assumed to be less than or equal to ± 25 kHz for Intelsat IX satellites over their lifetime. The tolerance over any one month is typically less than or equal to ± 2.5 kHz.

5.4.3 Spectrum Inversion

The transmitted RF carrier spectrum shall not be inverted with respect to the modulator output

5.5 Transmission Delay Variation Due to Satellite Motion

If carriers are to be interfaced with other synchronous data networks, it may be necessary to provide the receive station with elastic buffer storage facilities (or equivalent) to allow for time delay variations caused by satellite motion. The amount of storage necessary is affected by the satellite's maximum diurnal motion and longitudinal drift. It may be assumed that the maximum delay parameters to be expected for Intelsat IX will be as shown in Table 2.

5.6 Phase Noise

5.6.1 Earth Station Transmit

The single sideband phase noise on the transmitted carrier shall satisfy either one of the following two limits:

Limit 1 – The single sideband phase noise is assumed to consist of a continuous component and a spurious component. The single sideband power spectral density of the continuous component shall not exceed the envelope shown in Figure 1. A spurious component at the fundamental AC line frequency shall not exceed -30 dB relative to the level of the transmitted carrier. The single sideband sum (added on a power basis) of all other individual spurious components shall not exceed -36 dB relative to the level of the transmitted carrier. (The total phase noise including both sidebands can be up to 3 dB higher.)

or,

Limit 2: The single sideband phase noise due to both the continuous and spurious components integrated over the bandwidth 100 Hz to $0.3 R$ Hz away from the center frequency, where R is the maximum carrier transmission rate in bits per second, shall not exceed 2.2 degrees RMS. The total phase noise due to both sidebands shall not exceed 2.8 degrees RMS.

The option of satisfying either one of the two limits has been provided since it is possible for the phase noise spectrum to have various distributions which, when integrated, will have the same overall effect.

5.6.2 Earth Station Receive

The phase noise requirement for the receive earth station should be consistent with the carrier recovery system of the demodulator but, as a minimum, it is recommended that the phase noise requirement given in Section 5.6.1 be met.

Table 1

VSAT Carrier Performance Characteristics

Parameter				Units
1. Information Rates	64 to 8448			kbit/s
2. FEC*	Rate 1/2, 3/4 or 7/8 Turbo			
3. Energy Dispersal (Scrambling)	Per Figure 3 & Figure 4			
4. Modulation	QPSK / Offset QPSK			
5. Noise Bandwidth	0.5 x Tx Rate			
6. Allocated RF Bandwidth†	0.7 x Tx Rate			
7. Threshold Performance:				
• BER	10 ⁻⁸			
• Turbo Code Rate	1/2	3/4	7/8	
• E _b /N _o (IF Loopback)	3.2	4.4	4.5	dB
• E _b /N _o (via Sat Chan)	3.6	4.8	4.9	dB
8. Link Margin To Threshold:				
• C-Band (Uplink / Downlink)	2.0 / 2.0			dB
• Ku-Band (Uplink / Downlink)‡	5.5 / 8.0			dB
9. Clear-Sky Performance:				
• BER	Less than 10 ⁻¹⁰			
• Turbo Code Rate	1/2	3/4	7/8	
• E _b /N _o (IF Loopback)	5.2	6.4	6.5	dB
• E _b /N _o (via Sat Chan)	5.6	6.8	6.9	dB
10. Total Link Availability:				
• C-Band	99.9			% / yr
• Ku-Band	99.6			% / yr

* The optimum turbo code rate for any given link will be assigned by Intelsat.

† The allocated RF bandwidth is rounded to an odd integer multiple of 22.5 kHz.

‡ For Ku-Band operation, Intelsat may allocate an uplink / downlink margin up to the maximum values shown, depending on the local rainfall attenuation statistics at the receiving earth station site. The minimum Ku-Band uplink / downlink that will be allocated is 2.0 dB / 2.0 dB.

Table 2

Transmission Delay Variation Due To Satellite Motion

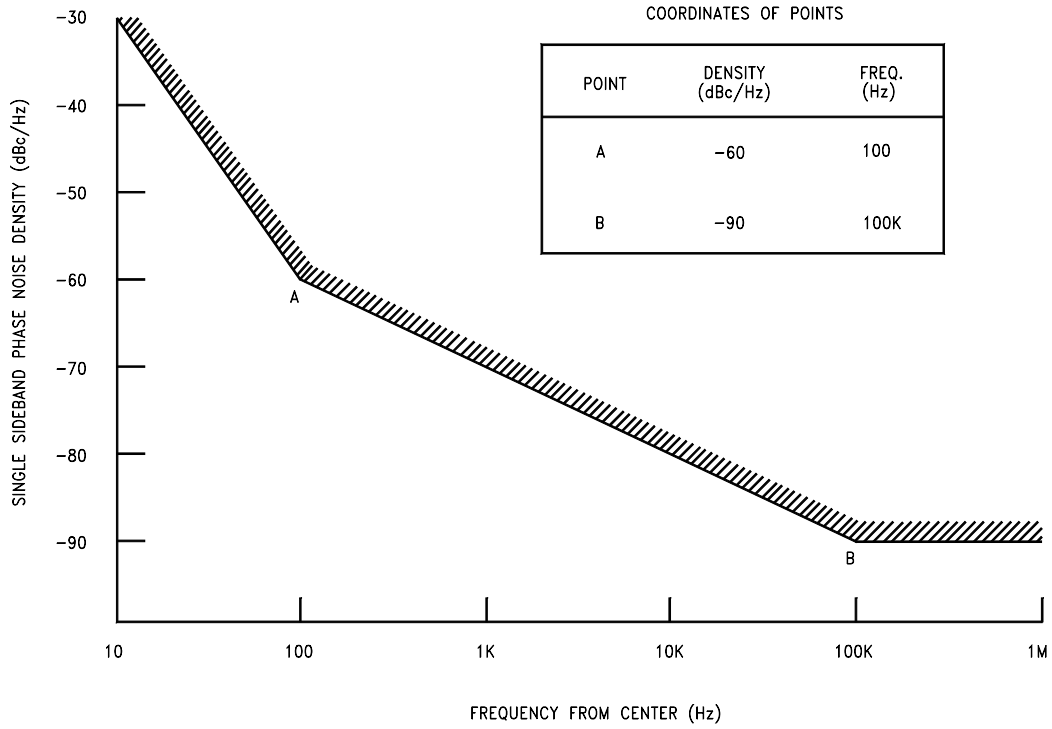
Satellite	Maximum Variation (1) (milliseconds)	Maximum Rate of Variations (2) (nanoseconds/second)
Intelsat IX	0.43	15.4

NOTES:

- (1) Maximum = peak-to-peak, uplink plus downlink.
- (2) Maximum = uplink plus downlink.

Figure 1

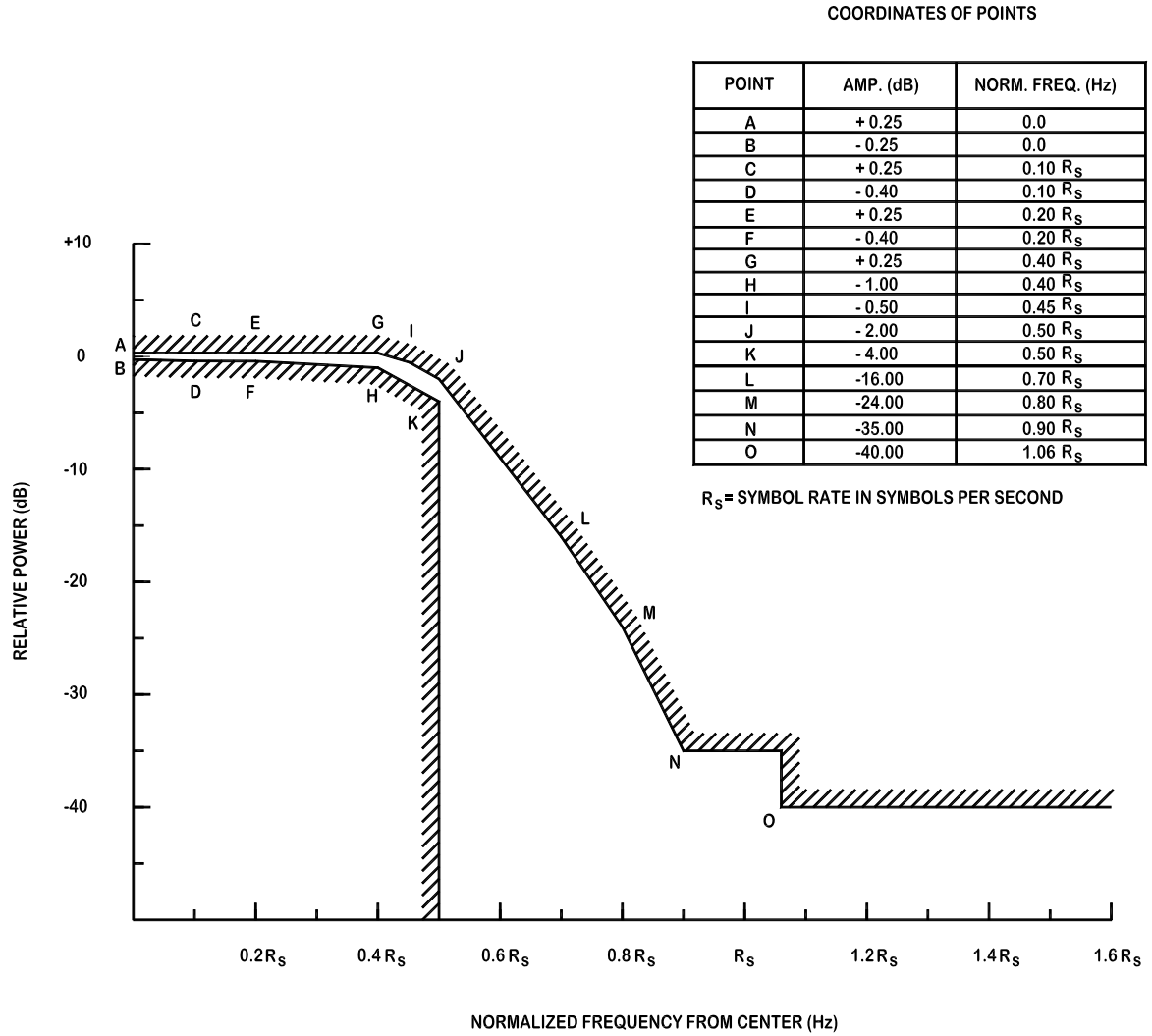
Transmit Earth Station Continuous
Single Sideband Phase Noise Requirement



CONTINUOUS SINGLE SIDEBAND PHASE NOISE REQUIREMENT

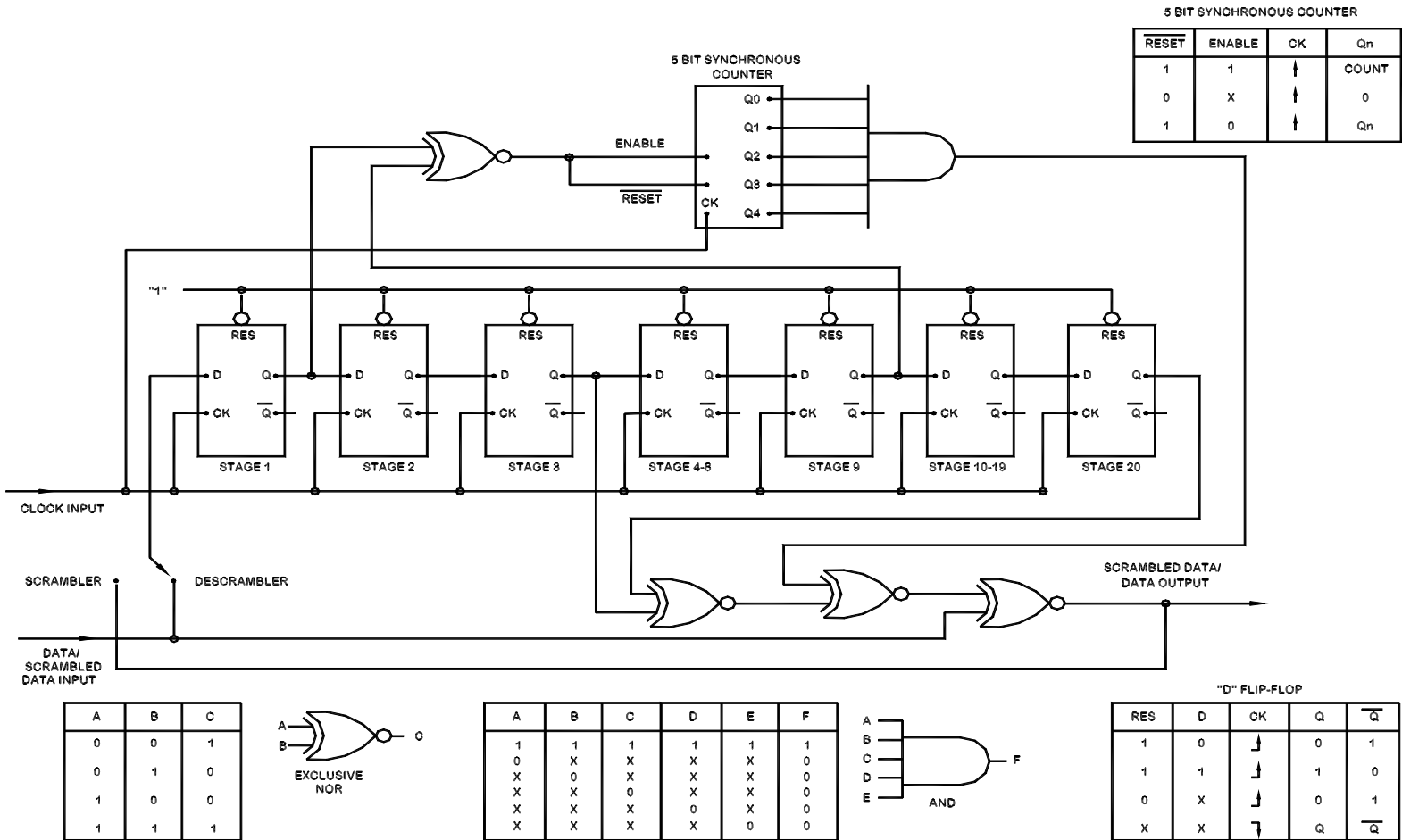
Figure 2

Power Spectral Density At Modulator Output



NOTES:
0 dB RELATIVE POWER CORRESPONDS TO $-10 \log R_s$ dB/Hz RELATIVE TO THE UNMODULATED CARRIER POWER.

Figure 3
Scrambler/Descrambler Logic Diagram



APPENDIX A

ITU REFERENCES

Radio Regulations

Appendix 3

TABLE OF MAXIMUM PERMITTED SPURIOUS EMISSION LEVELS

Radiocommunication Sector:

- | | |
|---------------------|---|
| Rec. ITU-R SF.358-5 | MAXIMUM PERMISSIBLE VALUES OF POWER FLUX DENSITY AT THE SURFACE OF THE EARTH PRODUCED BY SATELLITES IN THE FIXED-SATELLITE SERVICE USING THE SAME FREQUENCY BANDS ABOVE 1 GHz AS LINE-OF-SIGHT RADIO-RELAY SYSTEMS |
| Rec. ITU-R S.524-7 | MAXIMUM PERMISSIBLE LEVELS OF OFF-AXIS e.i.r.p. DENSITY FROM EARTH STATIONS IN GEOSTATIONARY-SATELLITE ORBIT NETWORKS OPERATING IN THE FIXED-SATELLITE SERVICE TRANSMITTING IN THE 6 GHz, 14 GHz AND 30 GHz FREQUENCY BANDS |
| Rec. ITU-R SM.329-9 | SPURIOUS EMISSIONS |
| Rec. ITU-R SM.1539 | VARIATION OF THE BOUNDARY BETWEEN THE OUT-OF-BAND AND SPURIOUS DOMAINS REQUIRED FOR THE APPLICATION OF RECOMMENDATIONS ITU-R SM.1541 AND ITU-R SM.329 |
| Rec. ITU-R SM.1541 | UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN |

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APPENDIX B

VSAT CARRIER TRANSMISSION PARAMETERS
(Intelsat IX)

APPENDIX B to
IESS-315
Page B-2

Table B.1
VSAT Carrier Transmission Parameters
(Intelsat IX, Rate 1/2 Turbo QPSK / OQPSK)

Info. Rate (IR) (bit/s)	Tx Rate (bit/s)	Noise BW (Hz)	Allocated BW (Hz)	Clear-sky C/T (dBW/K)	Clear-sky C/No (dB-Hz)	Clear-sky C/N (dB)
				< 10 ⁻¹⁰	< 10 ⁻¹⁰	< 10 ⁻¹⁰
64	128.00	64.00	112.5	-174.9	53.7	5.6
128	256.00	128.00	202.5	-171.9	56.7	5.6
192	384.00	192.00	292.5	-170.2	58.4	5.6
256	512.00	256.00	382.5	-168.9	59.7	5.6
384	768.00	384.00	562.5	-167.2	61.4	5.6
512	1024.00	512.00	742.5	-165.9	62.7	5.6
768	1536.00	768.00	1102.5	-164.1	64.5	5.6
1024	2048.00	1024.00	1462.5	-162.9	65.7	5.6
1544	3088.00	1544.00	2182.5	-161.1	67.5	5.6
2048	4096.00	2048.00	2857.5	-159.9	68.7	5.6
6312	12624.00	6312.00	8842.5	-155.0	73.6	5.6
8448	16896.00	8448.00	11857.5	-153.7	74.9	5.6

NOTES:

1. The above table illustrates parameters for typical information rates. Other information rates can also be accommodated.
2. The C/T, C/N₀ and C/N values have been calculated using a threshold E_b/N₀ of 3.6 dB (BER of 10⁻⁸) for Rate 1/2 turbo QPSK / OQPSK over a satellite channel and a system margin of 2.0 dB (C-Band). For Ku-Band operation, the system margin allocated can be up to a maximum of 5.5 dB (see Table 1).
3. Carrier frequency spacings will be odd integer multiples of 22.5 kHz.

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Table B.2
VSAT Carrier Transmission Parameters
(Intelsat IX, Rate 3/4 Turbo QPSK / OQPSK)

Info. Rate (IR) (bit/s)	Tx Rate (bit/s)	Noise BW (Hz)	Allocated BW (Hz)	Clear-sky C/T (dBW/K)	Clear-sky C/No (dB-Hz)	Clear-sky C/N (dB)
				$< 10^{-10}$	$< 10^{-10}$	$< 10^{-10}$
64	85.33	42.67	67.5	-173.7	54.9	8.6
128	170.67	85.33	112.5	-170.7	57.9	8.6
192	256.00	128.00	202.5	-169.0	59.6	8.6
256	341.33	170.67	247.5	-167.7	60.9	8.6
384	512.00	256.00	382.5	-166.0	62.6	8.6
512	682.67	341.33	472.5	-164.7	63.9	8.6
768	1024.00	512.00	742.5	-162.9	65.7	8.6
1024	1365.33	682.67	967.5	-161.7	66.9	8.6
1544	2058.67	1029.33	1462.5	-159.9	68.7	8.6
2048	2730.67	1365.33	1912.5	-158.7	69.9	8.6
6312	8416.00	4208.00	5917.5	-153.8	74.8	8.6
8448	11264.00	5632.00	7897.5	-152.5	76.1	8.6

NOTES:

1. The above table illustrates parameters for typical information rates. Other information rates can also be accommodated.
2. The C/T, C/No and C/N values have been calculated using a threshold E_b/N_o of 4.8 dB (BER of 10^{-8}) for Rate 3/4 turbo QPSK / OQPSK over a satellite channel and a system margin of 2.0 dB (C-Band). For Ku-Band operation, the system margin allocated can be up to a maximum of 5.5 dB (see Table 1).
3. Carrier frequency spacings will be odd integer multiples of 22.5 kHz.

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Table B.3
VSAT Carrier Transmission Parameters
(Intelsat IX, Rate 7/8 Turbo QPSK / OQPSK)

Info. Rate (IR) (bit/s)	Tx Rate (bit/s)	Noise BW (Hz)	Allocated BW (Hz)	Clear-sky C/T (dBW/K)	Clear-sky C/No (dB-Hz)	Clear-sky C/N (dB)
				< 10 ⁻¹⁰	< 10 ⁻¹⁰	< 10 ⁻¹⁰
64	73.14	36.57	67.5	-173.6	55.0	9.3
128	146.29	73.14	112.5	-170.6	58.0	9.3
192	219.43	109.71	157.5	-168.9	59.7	9.3
256	292.57	146.29	202.5	-167.6	61.0	9.3
384	438.86	219.43	337.5	-165.9	62.7	9.3
512	585.14	292.57	427.5	-164.6	64.0	9.3
768	877.71	438.86	607.5	-162.8	65.8	9.3
1024	1170.29	585.14	832.5	-161.6	67.0	9.3
1544	1764.57	882.29	1237.5	-159.8	68.8	9.3
2048	2340.57	1170.29	1642.5	-158.6	70.0	9.3
6312	7213.71	3606.86	5062.5	-153.7	74.9	9.3
8448	9654.86	4827.43	6772.5	-152.4	76.2	9.3

NOTES:

1. The above table illustrates parameters for typical information rates. Other information rates can also be accommodated.
2. The C/T, C/N₀ and C/N values have been calculated using a threshold E_b/N₀ of 4.9 dB (BER of 10⁻⁸) for Rate 7/8 turbo QPSK / OQPSK over a satellite channel and a system margin of 2.0 dB (C-Band). For Ku-Band operation, the system margin allocated can be up to a maximum of 5.5 dB (see Table 1).
3. Carrier frequency spacings will be odd integer multiples of 22.5 kHz.

APPENDIX C

EARTH STATION CONNECTIVITY MATRICES
(Intelsat IX)

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Page C-1

Table C.1

Earth Station Connectivity Matrix (Off-Axis Emission Margins) –
Intelsat IX, 6/4 GHz, 36 MHz Global

Receive Earth Station	Transmit Earth Station																							
	A			B			F-3			F-2			F-1			H-4			H-3			H-2		
	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8
A													20.0	17.1	16.2	20.0	17.1	16.2	13.2	10.3	9.4	10.7	7.8	6.9
B													18.4	15.6	14.7	18.4	15.6	14.7	11.6	8.8	7.9	9.1	6.3	5.4
F-3													16.7	13.8	13.0	16.7	13.8	13.0	9.9	7.0	6.2	7.4	4.5	3.7
F-2													15.1	11.5	10.6	15.1	11.5	10.6	8.3	4.7	3.8	5.8	2.2	1.3
F-1	23.0	17.6	16.8	19.5	14.1	13.3	18.2	12.8	12.0	16.8	11.4	10.6	10.9	5.5	4.7	10.9	5.5	4.7	4.1	-1.3	-2.1	1.6	-3.8	-4.6
H-4	22.2	17.1	16.3	18.7	13.6	12.8	17.4	12.3	11.5	16.0	10.9	10.1	10.1	5.0	4.2	10.1	5.0	4.2	3.3	-1.8	-2.6	0.8	-4.3	-5.1
H-3	16.8	14.1	13.3	13.3	10.6	9.8	12.0	9.3	8.5	10.6	7.9	7.1	4.7	2.0	1.2	4.7	2.0	1.2	-2.1	-4.8	-5.6	-4.6	-7.3	-8.1
H-2	14.1	11.3	10.4	10.6	7.8	6.9	9.3	6.5	5.6	7.9	5.1	4.2	2.0	-0.8	-1.7	2.0	-0.8	-1.7	-4.8	-7.6	-8.5	-7.3	-10.1	-11.0

NOTES:

- The above off-axis emission margins were computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above off-axis emission margins are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

<u>UPLINK</u>		<u>DOWNLINK</u>		<u>REGION</u>	<u>D/L EIRP</u> (dBW)	<u>S/C Location</u> (°E)
<u>BEAM</u>	<u>DIR.</u>	<u>BEAM</u>	<u>DIR.</u>			
Global	All	Global	All	All	31.0	All

- See the General Notes on page C-6.

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Table C.2

Earth Station Connectivity Matrix (Off-Axis Emission Margins) –
Intelsat IX, 6/4 GHz, 72 MHz Hemi/Zone

Receive Earth Station	Transmit Earth Station																							
	A			B			F-3			F-2			F-1			H-4			H-3			H-2		
	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8
A													22.6	19.6	18.7	22.6	19.6	18.7	15.8	12.8	11.9	13.3	10.3	9.4
B													21.7	18.6	17.8	21.7	18.6	17.8	14.9	11.8	11.0	12.4	9.3	8.5
F-3													20.7	17.6	16.7	20.7	17.6	16.7	13.9	10.8	9.9	11.4	8.3	7.4
F-2													19.2	16.0	15.1	19.2	16.0	15.1	12.4	9.2	8.3	9.9	6.7	5.8
F-1	28.4	22.7	21.9	24.9	19.2	18.4	23.6	17.9	17.1	22.2	16.5	15.7	16.3	10.6	9.8	16.3	10.6	9.8	9.5	3.8	3.0	7.0	1.3	0.5
H-4	27.8	22.2	21.4	24.3	18.7	17.9	23.0	17.4	16.6	21.6	16.0	15.2	15.7	10.1	9.3	15.7	10.1	9.3	8.9	3.3	2.5	6.4	0.8	0.0
H-3	21.6	18.9	18.1	18.1	15.4	14.6	16.8	14.1	13.3	15.4	12.7	11.9	9.5	6.8	6.0	9.5	6.8	6.0	2.7	0.0	-0.8	0.2	-2.5	-3.3
H-2	19.3	16.5	15.7	15.8	13.0	12.2	14.5	11.7	10.9	13.1	10.3	9.5	7.2	4.4	3.6	7.2	4.4	3.6	0.4	-2.4	-3.2	-2.1	-4.9	-5.7

NOTES:

- The above off-axis emission margins were computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above off-axis emission margins are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

<u>UPLINK</u>		<u>DOWNLINK</u>		<u>REGION</u>	<u>D/L EIRP</u>	<u>S/C Location</u>
<u>BEAM</u>	<u>DIR.</u>	<u>BEAM</u>	<u>DIR.</u>		(dBW)	(°E)
H/Z	All	H/Z	All	All	36.0	All

- See the General Notes on page C-6.

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Table C.3

Earth Station Connectivity Matrix (Off-Axis Emission Margins) –
Intelsat IX, 6/4 GHz, 36 MHz Hemi/Zone

Receive Earth Station	Transmit Earth Station																							
	A			B			F-3			F-2			F-1			H-4			H-3			H-2		
	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8
A										22.4	19.3	18.4	22.4	19.3	18.4	15.6	12.5	11.6	13.1	10.0	9.1			
B										21.4	18.3	17.5	21.4	18.3	17.5	14.6	11.5	10.7	12.1	9.0	8.2			
F-3										20.1	17.1	16.3	20.1	17.1	16.3	13.3	10.3	9.5	10.8	7.8	7.0			
F-2										18.7	15.8	14.9	18.7	15.8	14.9	11.9	9.0	8.1	9.4	6.5	5.6			
F-1	27.9	24.5	23.6	24.4	21.0	20.1	23.1	19.7	18.8	21.7	18.3	17.4	15.8	12.4	11.5	15.8	12.4	11.5	9.0	5.6	4.7	6.5	3.1	2.2
H-4	27.4	23.0	22.7	23.9	19.5	19.2	22.6	18.2	17.9	21.2	16.8	16.5	15.3	10.9	10.6	15.3	10.9	10.6	8.5	4.1	3.8	6.0	1.6	1.3
H-3	23.4	17.8	17.0	19.9	14.3	13.5	18.6	13.0	12.2	17.2	11.6	10.8	11.3	5.7	4.9	11.3	5.7	4.9	4.5	-1.1	-1.9	2.0	-3.6	-4.4
H-2	18.2	15.5	14.7	14.7	12.0	11.2	13.4	10.7	9.9	12.0	9.3	8.5	6.1	3.4	2.6	6.1	3.4	2.6	-0.7	-3.4	-4.2	-3.2	-5.9	-6.7

NOTES:

- The above off-axis emission margins were computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above off-axis emission margins are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

<u>UPLINK</u>		<u>DOWNLINK</u>		<u>REGION</u>	<u>D/L EIRP</u> (dBW)	<u>S/C Location</u> (°E)
<u>BEAM</u>	<u>DIR.</u>	<u>BEAM</u>	<u>DIR.</u>			
H/Z	All	H/Z	All	All	36.0	All

- See the General Notes on page C-6.

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Table C.4

Earth Station Connectivity Matrix (Off-Axis Emission Margins) –
Intelsat IX, 14/11 GHz, 72 MHz Spot Beam

Receive Earth Station	Transmit Earth Station																	
	C			E-3			E-2			E-1			K-3			K-2		
	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8
C										22.5	19.5	18.7	20.0	17.0	16.2	16.5	13.5	12.7
E-3										21.9	19.0	18.1	19.4	16.5	15.6	15.9	13.0	12.1
E-2										19.7	16.7	15.8	17.2	14.2	13.3	13.7	10.7	9.8
E-1	30.5	25.8	24.9	27.3	22.7	21.8	23.6	19.0	18.1	17.3	12.7	11.8	14.8	10.2	9.3	11.3	6.7	5.8
K-3	29.1	24.4	23.6	25.9	21.3	20.5	22.2	17.6	16.8	15.9	11.3	10.5	13.4	8.8	8.0	9.9	5.3	4.5
K-2	24.1	20.7	20.1	20.9	17.6	17.0	17.2	13.9	13.3	10.9	7.6	7.0	8.4	5.1	4.5	4.9	1.6	1.0

NOTES:

- The above off-axis emission margins were computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above off-axis emission margins are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

<u>UPLINK</u>		<u>DOWNLINK</u>		<u>D/L EIRP</u>	<u>S/C Location</u>
<u>BEAM</u>	<u>DIR.</u>	<u>BEAM</u>	<u>DIR.</u>	(dBW)	(°E)
Spot	All	Spot	All	47.0	All

- See the General Notes on page C-6.

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Table C.5

Earth Station Connectivity Matrix (Off-Axis Emission Margins) –
Intelsat IX, 14/11 GHz, 36 MHz Spot Beam

Receive Earth Station	Transmit Earth Station																	
	C			E-3			E-2			E-1			K-3			K-2		
	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8	1/2	3/4	7/8
C										22.3	19.4	18.5	19.8	16.9	16.0	16.3	13.4	12.5
E-3										21.7	18.7	17.8	19.2	16.2	15.3	15.7	12.7	11.8
E-2										19.3	16.5	15.6	16.8	14.0	13.1	13.3	10.5	9.6
E-1	30.0	26.9	26.1	26.8	23.8	23.0	23.1	20.1	19.3	16.8	13.8	13.0	14.3	11.3	10.5	10.8	7.8	7.0
K-3	28.7	25.4	24.6	25.5	22.3	21.5	21.8	18.6	17.8	15.5	12.3	11.5	13.0	9.8	9.0	9.5	6.3	5.5
K-2	25.5	20.9	20.1	22.3	17.8	17.0	18.6	14.1	13.3	12.3	7.8	7.0	9.8	5.3	4.5	6.3	1.8	1.0

NOTES:

- The above off-axis emission margins were computed using a saturation flux density of -78.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above off-axis emission margins are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

<u>UPLINK</u>		<u>DOWNLINK</u>		<u>D/L EIRP</u>	<u>S/C Location</u>
<u>BEAM</u>	<u>DIR.</u>	<u>BEAM</u>	<u>DIR.</u>	(dBW)	(°E)
Spot	All	Spot	All	47.0	All

- See the General Notes on page C-6.

GENERAL NOTES FOR TABLES C.1 THROUGH C.5
(Earth Station Connectivity Matrix)

1. The indicated off-axis emission margins assume: (a) the transmitting and receiving earth stations are located either 2 dB (C-Band) or 3 dB (Ku-Band) away from the edge of satellite's beam coverage on both the uplink and downlink; (b) the transmitting and receiving earth stations have an elevation look angle of 10°; and, (c) the transmitting earth station sidelobe performance is the minimum specified in IESS-207 (Standards A, B, F & H) or IESS-208 (Standards C, E & K).
2. A negative margin indicates the transmit/receive earth station connection does not comply with the off-axis emission requirements of Rec. ITU-R S.524-7.
3. Transmission paths which have a negative margin indicated may still be permitted if: (a) the transmitting and/or the receiving earth station has sufficient pattern advantage relative to beam edge or, (b) the transmitting earth station sidelobe performance exceeds the minimum specified in IESS-207 or IESS-208 by the indicated margin. Users should refer to the actual satellite beam coverage patterns to determine the appropriate uplink or downlink pattern advantage.

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APPENDIX D

EARTH STATION NOMINAL EIRP TABLES
(Intelsat IX)

Table D.1

VSAT Earth Station Maximum EIRP Capabilities
 (Rate 1/2 Turbo Offset QPSK, Single Carrier Per HPA)

C-Band Earth Stations

Standard	Size (m)	Tx Gain (1) (dBi)	Maximum EIRP Capability (2, 3, 5) (dBW)					EIRP Limit (4) Per Rec. ITU-R S.524-7 (dBW / 64 kbit/s)
			SSPA Size (Watts)					
			2	5	10	20	40	
F-1	3.7	45.7	47.7	51.7	54.7	57.7	60.7	60.7
H-4	3.7	45.7	47.7	51.7	54.7	57.7	60.7	60.7
H-3	2.4	41.9	43.9	47.9	50.9	53.9	56.9	53.9
H-2	1.8	39.4	41.1	45.4	48.4	51.4	54.4	51.4

Ku-Band Earth Stations

Standard	Size (m)	Tx Gain (1) (dBi)	Maximum EIRP Capability (2, 3) (dBW)					EIRP Limit (4) Per Rec. ITU-R S.524-7 (dBW / 64 kbit/s)
			SSPA Size (Watts)					
			2	4	8	12	16	
E-1	2.4	49.2	51.2	54.2	57.2	59.0	60.2	61.2
K-3	1.8	46.7	48.7	51.7	54.7	56.5	57.7	58.7
K-2	1.2	43.2	45.2	48.2	51.2	53.0	54.2	55.2

See Notes to Table D.1 on page D-5

Table D.2

VSAT Earth Station Maximum EIRP Capabilities
 (Rate 3/4 Turbo Offset QPSK, Single Carrier Per HPA)

C-Band Earth Stations

Standard	Size (m)	Tx Gain (1) (dBi)	Maximum EIRP Capability (2, 3, 5) (dBW)					EIRP Limit (4) Per Rec. ITU-R S.524-7 (dBW / 64 kbit/s)
			SSPA Size (Watts)					
			2	5	10	20	40	
F-1	3.7	45.7	47.7	51.7	54.7	57.7	60.7	59.0
H-4	3.7	45.7	47.7	51.7	54.7	57.7	60.7	59.0
H-3	2.4	41.9	43.9	47.9	50.9	53.9	56.9	52.2
H-2	1.8	39.4	41.1	45.4	48.4	51.4	54.4	49.7

Ku-Band Earth Stations

Standard	Size (m)	Tx Gain (1) (dBi)	Maximum EIRP Capability (2, 3, 5) (dBW)					EIRP Limit (4) Per Rec. ITU-R S.524-7 (dBW / 64 kbit/s)
			SSPA Size (Watts)					
			2	4	8	12	16	
E-1	2.4	49.2	51.2	54.2	57.2	59.0	60.2	59.5
K-3	1.8	46.7	48.7	51.7	54.7	56.5	57.7	57.0
K-2	1.2	43.2	45.2	48.2	51.2	53.0	54.2	53.5

See Notes to Table D.2 on page D-5

Table D.3

VSAT Earth Station Maximum EIRP Capabilities
 (Rate 7/8 Turbo Offset QPSK, Single Carrier Per HPA)

C-Band Earth Stations

Standard	Size (m)	Tx Gain (1) (dBi)	Maximum EIRP Capability (2, 3, 5) (dBW)					EIRP Limit (4) Per Rec. ITU-R S.524-7 (dBW / 64 kbit/s)
			SSPA Size (Watts)					
			2	5	10	20	40	
F-1	3.7	45.7	47.7	51.7	54.7	57.7	60.7	58.3
H-4	3.7	45.7	47.7	51.7	54.7	57.7	60.7	58.3
H-3	2.4	41.9	43.9	47.9	50.9	53.9	56.9	51.5
H-2	1.8	39.4	41.1	45.4	48.4	51.4	54.4	49.0

Ku-Band Earth Stations

Standard	Size (m)	Tx Gain (1) (dBi)	Maximum EIRP Capability (2, 3, 5) (dBW)					EIRP Limit (4) Per Rec. ITU-R S.524-7 (dBW / 64 kbit/s)
			SSPA Size (Watts)					
			2	4	8	12	16	
E-1	2.4	49.2	51.2	54.2	57.2	59.0	60.2	58.8
K-3	1.8	46.7	48.7	51.7	54.7	56.5	57.7	56.3
K-2	1.2	43.2	45.2	48.2	51.2	53.0	54.2	52.8

See Notes to Table D.3 on page D-5.

Notes to Tables D.1 to D.3

1. Antenna transmit efficiency (@ 6.175 GHz; 14.25 GHz) = 65%
2. SSPA output backoff (single carrier) = 0.5 dB (Offset QPSK only). For QPSK, a minimum SSPA output backoff of 3.0 dB is recommended and, therefore, the maximum EIRP capabilities shown in Table D.1 to Table D.3 must be reduced by 2.5 dB.
3. Transmit line loss = 0.5 dB
4. The ITU-R EIRP limits shown in Table D.1, D.2 and D.3 are based on a 64 kbit/s Rate 1/2 Turbo QPSK/OQPSK carrier, a Rate 3/4 Turbo QPSK/OQPSK carrier and a Rate 7/8 Turbo QPSK/OQPSK carrier, respectively. For other information rates higher than 64 kbit/s, the ITU-R EIRP limit will increase by a factor equal to $10 \times \log_{10}(\text{Information rate (kbit/s)} \div 64 \text{ kbit/s})$.
5. The shaded EIRP values indicate they exceed the ITU-R's off-axis EIRP density limit.

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Table D.4

Nominal Earth Station EIRP (dBW) for Rate 1/2 Turbo QPSK / OQPSK
(Intelsat IX, 36 MHz Global-to-Global, 2 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)							
	A	B	F-3	F-2	F-1	H-4	H-3	H-2
Info Rate (kbit/s)								
64	40.7	42.3	44.0	45.6	49.8	50.6	56.0	58.7
128	43.7	45.3	47.0	48.6	52.8	53.6	59.0	61.7
192	45.5	47.1	48.8	50.4	54.6	55.4	60.8	63.5
256	46.7	48.3	50.0	51.6	55.8	56.6	62.0	64.7
384	48.5	50.1	51.8	53.4	57.6	58.4	63.8	66.5
512	49.7	51.3	53.0	54.6	58.8	59.6	65.0	67.7
768	51.5	53.1	54.8	56.4	60.6	61.4	66.8	69.5
1024	52.7	54.3	56.0	57.6	61.8	62.6	68.0	70.7
1544	54.5	56.1	57.8	59.4	63.6	64.4	69.8	72.5
2048	55.8	57.4	59.1	60.7	64.9	65.7	71.1	73.8
6312	60.6	62.2	63.9	65.5	69.7	70.5	75.9	78.6
8448	61.9	63.5	65.2	66.8	71.0	71.8	77.2	79.9
X (for other info. rates)	-7.4	-5.8	-4.1	-2.5	1.7	2.5	7.9	10.6

NOTES:

- These nominal EIRP values have been computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L EIRP	U/L Margin	D/L Margin	S/C Location
BEAM	DIR.	BEAM	DIR.		(dBW)	(dB)	(dB)	(°E)
Global	All	Global	All	All	31.0	2.0	2.0	All

- See the General Notes on page D-16.

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Table D.5

Nominal Earth Station EIRP (dBW) for Rate 3/4 Turbo QPSK / OQPSK
(Intelsat IX, 36 MHz Global-to-Global, 2 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)							
	A	B	F-3	F-2	F-1	H-4	H-3	H-2
Info Rate (kbit/s)								
64	41.9	43.4	45.2	47.5	53.5	54.0	57.0	59.8
128	44.9	46.4	48.2	50.5	56.5	57.0	60.0	62.8
192	46.7	48.2	50.0	52.3	58.3	58.8	61.8	64.6
256	47.9	49.4	51.2	53.5	59.5	60.0	63.0	65.8
384	49.7	51.2	53.0	55.3	61.3	61.8	64.8	67.6
512	50.9	52.4	54.2	56.5	62.5	63.0	66.0	68.8
768	52.7	54.2	56.0	58.3	64.3	64.8	67.8	70.6
1024	53.9	55.4	57.2	59.5	65.5	66.0	69.0	71.8
1544	55.7	57.2	59.0	61.3	67.3	67.8	70.8	73.6
2048	57.0	58.5	60.3	62.6	68.6	69.1	72.1	74.9
6312	61.8	63.3	65.1	67.4	73.4	73.9	76.9	79.7
8448	63.1	64.6	66.4	68.7	74.7	75.2	78.2	81.0
X (for other info. rates)	-6.2	-4.7	-2.9	-0.6	5.4	5.9	8.9	11.7

NOTES:

- These EIRP values have been computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- For Rate 7/8 turbo QPSK/OQPSK, add 0.2 dB to the above EIRP values.
- The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L EIRP	U/L Margin	D/L Margin	S/C Location
BEAM	DIR.	BEAM	DIR.		(dBW)	(dB)	(dB)	(°E)
Global	All	Global	All	All	31.0	2.0	2.0	All

- See the General Notes on page D-16.

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Table D.6

Nominal Earth Station EIRP (dBW) for Rate 1/2 Turbo QPSK / OQPSK
(Intelsat IX, 72 MHz Hemi/Zone-to-Hemi/Zone, 2 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)							
	A	B	F-3	F-2	F-1	H-4	H-3	H-2
Info Rate (kbit/s)								
64	38.1	39.0	40.0	41.5	44.4	45.0	51.2	53.5
128	41.1	42.0	43.0	44.5	47.4	48.0	54.2	56.5
192	42.9	43.8	44.8	46.3	49.2	49.8	56.0	58.3
256	44.1	45.0	46.0	47.5	50.4	51.0	57.2	59.5
384	45.9	46.8	47.8	49.3	52.2	52.8	59.0	61.3
512	47.1	48.0	49.0	50.5	53.4	54.0	60.2	62.5
768	48.9	49.8	50.8	52.3	55.2	55.8	62.0	64.3
1024	50.1	51.0	52.0	53.5	56.4	57.0	63.2	65.5
1544	51.9	52.8	53.8	55.3	58.2	58.8	65.0	67.3
2048	53.2	54.1	55.1	56.6	59.5	60.1	66.3	68.6
6312	58.0	58.9	59.9	61.4	64.3	64.9	71.1	73.4
8448	59.3	60.2	61.2	62.7	65.6	66.2	72.4	74.7
X (for other info. rates)	-10.0	-9.1	-8.1	-6.6	-3.7	-3.1	3.1	5.4

NOTES:

- These EIRP values have been computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L EIRP	U/L Margin	D/L Margin	S/C Location
BEAM	DIR.	BEAM	DIR.		(dBW)	(dB)	(dB)	(°E)
H/Z	All	H/Z	All	All	36.0	2.0	2.0	All

- See the General Notes on page D-16.

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Table D.7

Nominal Earth Station EIRP (dBW) for Rate 3/4 Turbo QPSK / OQPSK
(Intelsat IX, 72 MHz Hemi/Zone-to-Hemi/Zone, 2 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)							
	A	B	F-3	F-2	F-1	H-4	H-3	H-2
Info Rate (kbit/s)								
64	39.4	40.4	41.4	43.0	48.4	48.9	52.2	54.6
128	42.4	43.4	44.4	46.0	51.4	51.9	55.2	57.6
192	44.2	45.2	46.2	47.8	53.2	53.7	57.0	59.4
256	45.4	46.4	47.4	49.0	54.4	54.9	58.2	60.6
384	47.2	48.2	49.2	50.8	56.2	56.7	60.0	62.4
512	48.4	49.4	50.4	52.0	57.4	57.9	61.2	63.6
768	50.2	51.2	52.2	53.8	59.2	59.7	63.0	65.4
1024	51.4	52.4	53.4	55.0	60.4	60.9	64.2	66.6
1544	53.2	54.2	55.2	56.8	62.2	62.7	66.0	68.4
2048	54.5	55.5	56.5	58.1	63.5	64.0	67.3	69.7
6312	59.3	60.3	61.3	62.9	68.3	68.8	72.1	74.5
8448	60.6	61.6	62.6	64.2	69.6	70.1	73.4	75.8
X (for other info. rates)	-8.7	-7.7	-6.7	-5.1	0.3	0.8	4.1	6.5

NOTES:

- These EIRP values have been computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- For Rate 7/8 turbo QPSK/OQPSK, add 0.2 dB to the above EIRP values.
- The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L EIRP	U/L Margin	D/L Margin	S/C Location
BEAM	DIR.	BEAM	DIR.		(dBW)	(dB)	(dB)	(°E)
H/Z	All	H/Z	All	All	36.0	2.0	2.0	All

- See the General Notes on page D-16.

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Table D.8

Nominal Earth Station EIRP (dBW) for Rate 1/2 Turbo QPSK / OQPSK
(Intelsat IX, 36 MHz Hemi/Zone-to-Hemi/Zone, 2 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)							
	A	B	F-3	F-2	F-1	H-4	H-3	H-2
Info Rate (kbit/s)								
64	38.3	39.3	40.6	42.0	44.9	45.4	49.4	54.6
128	41.3	42.3	43.6	45.0	47.9	48.4	52.4	57.6
192	43.1	44.1	45.4	46.8	49.7	50.2	54.2	59.4
256	44.3	45.3	46.6	48.0	50.9	51.4	55.4	60.6
384	46.1	47.1	48.4	49.8	52.7	53.2	57.2	62.4
512	47.3	48.3	49.6	51.0	53.9	54.4	58.4	63.6
768	49.1	50.1	51.4	52.8	55.7	56.2	60.2	65.4
1024	50.3	51.3	52.6	54.0	56.9	57.4	61.4	66.6
1544	52.1	53.1	54.4	55.8	58.7	59.2	63.2	68.4
2048	53.4	54.4	55.7	57.1	60.0	60.5	64.5	69.7
6312	58.2	59.2	60.5	61.9	64.8	65.3	69.3	74.5
8448	59.5	60.5	61.8	63.2	66.1	66.6	70.6	75.8
X (for other info. rates)	-9.8	-8.8	-7.5	-6.1	-3.2	-2.7	1.3	6.5

NOTES:

- These EIRP values have been computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L EIRP	U/L Margin	D/L Margin	S/C Location
BEAM	DIR.	BEAM	DIR.		(dBW)	(dB)	(dB)	(°E)
H/Z	All	H/Z	All	All	36.0	2.0	2.0	All

- See the General Notes on page D-16.

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Table D.9

Nominal Earth Station EIRP (dBW) for Rate 3/4 Turbo QPSK / OQPSK
(Intelsat IX, 36 MHz Hemi/Zone-to-Hemi/Zone, 2 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)							
	A	B	F-3	F-2	F-1	H-4	H-3	H-2
Info Rate (kbit/s)								
64	39.7	40.7	41.9	43.2	46.6	48.1	53.3	55.6
128	42.7	43.7	44.9	46.2	49.6	51.1	56.3	58.6
192	44.5	45.5	46.7	48.0	51.4	52.9	58.1	60.4
256	45.7	46.7	47.9	49.2	52.6	54.1	59.3	61.6
384	47.5	48.5	49.7	51.0	54.4	55.9	61.1	63.4
512	48.7	49.7	50.9	52.2	55.6	57.1	62.3	64.6
768	50.5	51.5	52.7	54.0	57.4	58.9	64.1	66.4
1024	51.7	52.7	53.9	55.2	58.6	60.1	65.3	67.6
1544	53.5	54.5	55.7	57.0	60.4	61.9	67.1	69.4
2048	54.8	55.8	57.0	58.3	61.7	63.2	68.4	70.7
6312	59.6	60.6	61.8	63.1	66.5	68.0	73.2	75.5
8448	60.9	61.9	63.1	64.4	67.8	69.3	74.5	76.8
X (for other info. rates)	-8.4	-7.4	-6.2	-4.9	-1.5	0.0	5.2	7.5

NOTES:

1. These EIRP values have been computed using a saturation flux density of -80.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
2. For Rate 7/8 turbo QPSK/OQPSK, add 0.2 dB to the above EIRP values.
3. The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L EIRP	U/L Margin	D/L Margin	S/C Location
BEAM	DIR.	BEAM	DIR.		(dBW)	(dB)	(dB)	(°E)
H/Z	All	H/Z	All	All	36.0	2.0	2.0	All

4. See the General Notes on page D-16.

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Table D.10

Nominal Earth Station EIRP (dBW) for Rate 1/2 Turbo QPSK / OQPSK
(Intelsat IX, 72 MHz Spot-to-Spot, 3 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)					
	C	E-3	E-2	E-1	K-3	K-2
Info. Rate (kbit/s)						
64	38.7	39.3	41.5	43.9	45.3	50.3
128	41.7	42.3	44.5	46.9	48.3	53.3
192	43.5	44.1	46.3	48.7	50.1	55.1
256	44.7	45.3	47.5	49.9	51.3	56.3
384	46.5	47.1	49.3	51.7	53.1	58.1
512	47.7	48.3	50.5	52.9	54.3	59.3
768	49.5	50.1	52.3	54.7	56.1	61.1
1024	50.7	51.3	53.5	55.9	57.3	62.3
1544	52.5	53.1	55.3	57.7	59.1	64.1
2048	53.8	54.4	56.6	59.0	60.4	65.4
6312	58.6	59.2	61.4	63.8	65.2	70.2
8448	59.9	60.5	62.7	65.1	66.5	71.5
X (for other info. rates)	-9.4	-8.8	-6.6	-4.2	-2.8	2.2

NOTES:

- These EIRP values have been computed using a saturation flux density of -78.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L	U/L	D/L	S/C
BEAM	DIR.	BEAM	DIR.		EIRP	Margin	Margin	Location
					(dBW)	(dB)	(dB)	(°E)
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	All
Spot 2	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	

- See the General Notes on page D-16.

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Table D.11

Nominal Earth Station EIRP (dBW) for Rate 3/4 Turbo QPSK / OQPSK
(Intelsat IX, 72 MHz Spot-to-Spot, 3 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)					
	C	E-3	E-2	E-1	K-3	K-2
Info. Rate (kbit/s)						
64	40.0	40.5	42.8	46.8	48.2	51.9
128	43.0	43.5	45.8	49.8	51.2	54.9
192	44.8	45.3	47.6	51.6	53.0	56.7
256	46.0	46.5	48.8	52.8	54.2	57.9
384	47.8	48.3	50.6	54.6	56.0	59.7
512	49.0	49.5	51.8	55.8	57.2	60.9
768	50.8	51.3	53.6	57.6	59.0	62.7
1024	52.0	52.5	54.8	58.8	60.2	63.9
1544	53.8	54.3	56.6	60.6	62.0	65.7
2048	55.1	55.6	57.9	61.9	63.3	67.0
6312	59.9	60.4	62.7	66.7	68.1	71.8
8448	61.2	61.7	64.0	68.0	69.4	73.1
X (for other info. rates)	-8.1	-7.6	-5.3	-1.3	0.1	3.8

NOTES:

1. These EIRP values have been computed using a saturation flux density of -78.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
2. For Rate 7/8 turbo QPSK/OQPSK, add 0.2 dB to the above EIRP values.
3. The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L	U/L	D/L	S/C
BEAM	DIR.	BEAM	DIR.		EIRP	Margin	Margin	Location
					(dBW)	(dB)	(dB)	(°E)
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	All
Spot 2	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	

4. See the General Notes on page D-16.

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Table D.12

Nominal Earth Station EIRP (dBW) for Rate 1/2 Turbo QPSK / OQPSK
(Intelsat IX, 36 MHz Spot-to-Spot, 3 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)					
	C	E-3	E-2	E-1	K-3	K-2
Info. Rate (kbit/s)						
64	38.9	39.5	41.9	44.4	45.7	48.9
128	41.9	42.5	44.9	47.4	48.7	51.9
192	43.7	44.3	46.7	49.2	50.5	53.7
256	44.9	45.5	47.9	50.4	51.7	54.9
384	46.7	47.3	49.7	52.2	53.5	56.7
512	47.9	48.5	50.9	53.4	54.7	57.9
768	49.7	50.3	52.7	55.2	56.5	59.7
1024	50.9	51.5	53.9	56.4	57.7	60.9
1544	52.7	53.3	55.7	58.2	59.5	62.7
2048	54.0	54.6	57.0	59.5	60.8	64.0
6312	58.8	59.4	61.8	64.3	65.6	68.8
8448	60.1	60.7	63.1	65.6	66.9	70.1
X (for other info. rates)	-9.2	-8.6	-6.2	-3.7	-2.4	0.8

NOTES:

- These EIRP values have been computed using a saturation flux density of -78.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
- The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK			D/L EIRP	U/L Margin	D/L Margin	S/C Location
BEAM	DIR.	BEAM	DIR.	REGION	(dBW)	(dB)	(dB)	(°E)
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	All
Spot 2	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	

- See the General Notes on page D-16.

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Table D.13

Nominal Earth Station EIRP (dBW) for Rate 3/4 Turbo QPSK / OQPSK
(Intelsat IX, 36 MHz Spot-to-Spot, 3 dB U/L & D/L Pattern Advantage)

Rx Station	EIRP (dBW)					
	C	E-3	E-2	E-1	K-3	K-2
Info. Rate (kbit/s)						
64	40.1	40.8	43.0	45.7	47.2	51.7
128	43.1	43.8	46.0	48.7	50.2	54.7
192	44.9	45.6	47.8	50.5	52.0	56.5
256	46.1	46.8	49.0	51.7	53.2	57.7
384	47.9	48.6	50.8	53.5	55.0	59.5
512	49.1	49.8	52.0	54.7	56.2	60.7
768	50.9	51.6	53.8	56.5	58.0	62.5
1024	52.1	52.8	55.0	57.7	59.2	63.7
1544	53.9	54.6	56.8	59.5	61.0	65.5
2048	55.2	55.9	58.1	60.8	62.3	66.8
6312	60.0	60.7	62.9	65.6	67.1	71.6
8448	61.3	62.0	64.2	66.9	68.4	72.9
X (for other info. rates)	-8.0	-7.3	-5.1	-2.4	-0.9	3.6

NOTES:

1. These EIRP values have been computed using a saturation flux density of -78.0 dBW/m^2 for full transponder loading conditions. Other saturation flux densities may be used depending on the actual traffic loading.
2. For Rate 7/8 turbo QPSK/OQPSK, add 0.2 dB to the above EIRP values.
3. The above EIRP values are applicable for the following uplink/downlink beam connections, Ocean Regions and spacecraft locations:

UPLINK		DOWNLINK		REGION	D/L	U/L	D/L	S/C
BEAM	DIR.	BEAM	DIR.		EIRP	Margin	Margin	Location
					(dBW)	(dB)	(dB)	(°E)
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 1	All	Spot 2	All	All	47.0	5.5	8.0	All
Spot 2	All	Spot 1	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	
Spot 2	All	Spot 2	All	All	47.0	5.5	8.0	

4. See the General Notes on page D-16.

GENERAL NOTES FOR TABLES D.4 THROUGH D.13
(Nominal Earth Station EIRP for Intelsat IX)

1. The nominal EIRP values provided in these tables assume earth stations have an elevation look angle of 10° and are located away from the edge of the satellite antenna beam coverage (i.e., benefit from having an uplink / downlink beam pattern advantage). For C-Band links, an uplink / downlink pattern advantage of 2 dB / 2 dB was assumed; for Ku-Band links, 3 dB / 3 dB was assumed. To determine the proper sizing for their earth station HPA, users will need to perform link budget calculations taking into consideration the specific characteristics of their link.
2. The EIRP values shown in Table D.4 through Table D.13 assume an aggregate adjacent satellite interference (ASI) contribution of 20% of the total noise. For 2° orbital spacing operation, the EIRP values may need to be increased by up to 1 dB to improve protection against ASI.
3. The EIRP values are shown only for example information rates. For other information rates, the EIRP can be computed using the following formula:

$$\text{EIRP} = X + 10 \log (\text{IR}), \text{ in dBW.}$$

where: X = the value for other information rates (shown in Table D.4 through Table D.13).

IR = Information rate, in bits per second.

APPENDIX E

REVISION HISTORY

<u>Revision No.</u>	<u>Approval Date</u>	<u>Major Purpose</u>
Original	20 Dec 2002	<ul style="list-style-type: none">• New module.