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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

158-SAT-AMEND-96

In re Application of	)	
	)	
MOBILE COMMUNICATIONS HOLDINGS, INC.	)	File No. 11-DSS-P-91(6); 18-DSS-P-91 (18) 11-SAT-LA-95; 12-SAT-AMEND-95
	)	
	)	
	)	
	)	
For Authority to Construct, Launch and Operate ELLIPSO™, An Elliptical Low Earth Orbit Mobile Satellite System in the 1610-1626.5 MHz and 2483.5-2500 MHz Bands	)	
	)	

AMENDMENT TO ELLIPSO™ SATELLITE SYSTEM APPLICATION

MOBILE COMMUNICATIONS
HOLDINGS, INC.
1120 19th Street, N.W.
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Of Counsel:

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(202) 663-8380

September 16, 1996

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In re Application of	)	
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SUPPLEMENT TO ELLIPSO™ SATELLITE SYSTEM APPLICATION

MOBILE COMMUNICATIONS
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Of Counsel:

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November 13, 1996

SUPPLEMENT TO APPLICATION

Mobile Communications Holdings, Inc. (MCHI) hereby provides supplemental information for association with its application for licensing of the ELLIPSO™ satellite system. This information includes supplemental financial materials evidencing the current availability of sufficient funds for construction, launch and first-year operation of the ELLIPSO™ system. These financial materials, which include letters of commitment from MCHI's investors and financiers, are submitted in lieu of the underlying business agreements previously submitted to the Commission on September 16, 1996 with a request for confidentiality. Submission of the supplemental financial information was expressly authorized in an October 29, 1996 letter from International Bureau Chief Donald Gips which confirmed MCHI's understanding that submission of proprietary business agreements is not mandatory under the Commission's Big LEO rules.

In addition, MCHI provides herewith updated technical information about the ELLIPSO™ system which reflects minor changes required to conform to the WRC-95 feeder link allocations and to facilitate sharing in the Big LEO frequency bands.

This supplemental filing includes the following items.

1. Letter of commitment from Vula Communications (Pty) Limited confirming its irrevocable commitment to pay MCHI the amount of US $350 million for certain international distribution and other rights pursuant to a September 12, 1996 agreement between the parties. The letter summarizes the material terms of the agreement and confirms Vula's capability to perform its financial obligations under the agreement. In its September 16, 1996 amendment, MCHI identified the current members of the Vula

consortium which include substantial and well-respected organizations in South Africa. A letter from Ernst & Young confirming the consortium membership is also attached. Additional details about these organizations are included. See Attachment 1.

2. Letter of commitment from P.T.Tigamutiara Buanakhatulistiwa (TMBK), a member of the Mertju Buana Group of Indonesia, signed by its President Director confirming its irrevocable commitment to provide vendor financing in the amount of US$300 million to provide the launch and associated launch services for seventeen ELLIPSO™ satellites pursuant to an agreement between the parties dated September 4, 1996. The letter of commitment summarizes the material terms of the agreement and confirms TMBK's capability to perform its financial obligations under the agreement. The Mertju Buana Group is a major, privately-owned Indonesian conglomerate with interests in many sectors including mining, real estate, food processing, and automobiles (local partner of General Motors in Indonesia). The letter is also signed by the State Design Office Yuzhnoye, a party to the September 4, 1996 agreement and developer of the Cyclone launch vehicle, which has committed to provide alternative sourcing on the same terms if TMBK is unable to provide the required launch capability within the time period required to meet implementation milestones. See Attachment 2.

3. Letter of commitment from Artoc and excerpt from agreement between MCHI and Artoc confirming Artoc's irrevocable commitment to pay MCHI the amount of US$300 million for certain international distribution rights. A certification from

Artoc's auditors confirming Artoc's ability to meet its financial obligations under the agreement is also attached. See Attachment 3.

4. November 16, 1994 letter from Arianespace confirming the availability of a credit commitment of US$45 million from Ariane, representing 15% of the financing required to provide launch services for two dedicated Ariane 5 launches. A launch services agreement was fully negotiated by the parties, and this agreement and a related credit agreement have been on hold since the FCC's January 31, 1995 decision to defer MCHI's application. See Attachment 4.

5. Letter of commitment from Spectrum Astro, Inc. confirming its commitment to provide vendor financing in the amount of $206 million to MCHI for construction of the sixteen first-generation ELLIPSO™ satellites by Spectrum Astro pursuant to an agreement between the parties dated June 26, 1996. The letter summarizes the material terms of the vendor financing agreement and confirms Spectrum Astro's capability to meet its financial obligations under the agreement. See Attachment 5.

6. Information on ELLIPSO's global pricing structure demonstrating that ELLIPSO™ will provide fixed and mobile services at costs comparable to terrestrial services: $0.12 per minute for fixed service and $0.50-$0.24 per minute for mobile service. See Attachment 6. Since ELLIPSO's first filing in November 1990, as the first Big LEO applicant, its innovative design has consistently provided for lower costs that are still substantially less than the service costs projected by the three licensed Big LEO

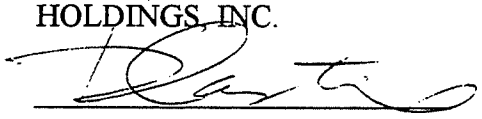
systems. MCHI's long-standing and vigorous objections to the Commission's inequitable exclusion of ELLIPSO™ from the marketplace need not be restated here.

7. Revised tables and figures reflecting certain minor revisions in technical information for the ELLIPSO™ system, including revised feeder link calculations, to conform to the Big LEO feeder link allocations adopted at the 1995 World Radiocommunication Conference and to facilitate sharing of the Big LEO frequencies. See Attachment 7. As noted in MCHI's September 16, 1996 amendment, the WRC-95 feeder link allocation required MCHI to reduce its proposed feeder link spectrum requirements from 300 MHz in each direction to 200 MHz in each direction.

MCHI has conclusively demonstrated its qualifications --- financial, technical and legal --- to be a Commission licensee and urges the Commission to move forward expeditiously with processing and grant of the ELLIPSO™ license application. From a public interest standpoint, grant of MCHI's application will authorize much-needed competition in the Big LEO marketplace and provide consumers with an innovative and lower-cost communications alternative.

Respectfully submitted,

MOBILE COMMUNICATIONS HOLDINGS, INC.

By: 

Dr. David Castiel
President and Chief Executive Officer

Date: November 13, 1996

TECHNICAL EXHIBIT

In this Technical Exhibit, MCHI provides revised tables and figures reflecting minor changes in the ELLIPSO™ system to conform to the Big LEO feeder link allocations and other international requirements adopted at WRC-95, and to facilitate sharing of the Big LEO frequencies.

In its September 16, 1996 amendment, MCHI reconfirmed its preferred feeder link frequencies in order to conform to the Big LEO feeder link allocations adopted at WRC-95. In MCHI's November 1994 filing, it specified the use of 300 MHz of feeder link spectrum in each direction (a total of 600 MHz). Due to limitations on the availability of Big LEO feeder link spectrum as a result of WRC-95, MCHI has reduced its feeder link requirements to specify a minimum of 200 MHz in each direction in the 6875-7075 MHz (downlink) and 15.45-15.65 GHz (uplink) bands (a total of 400 MHz). In addition, MCHI has simplified ELLIPSO's feeder link antennas from an array of two sector and one earth coverage antennas to a single earth coverage antenna in each feeder link direction.

MCHI has also changed its user link channelizing scheme to one using multiples of 2.5 MHz in order to facilitate spectrum sharing with the other Big LEO systems.

Revised figures and tables are attached hereto reflecting these minor changes and should be substituted in lieu of previously submitted figures and tables. Except as revised in the attached technical materials, the characteristics and specifications of the ELLIPSO™ system are as stated in MCHI's November 1994 amendment.

- Figure 1 shows a numbered layout of the 61 ELLIPSO™ user beams. Seventy feeder link slots carry user signals to and from the satellite as shown in Figures 2 and 3.

- Telemetry, Tracking, and command link will use spectrum within the uplink and downlink feeder link spectrum, as shown in Figures 2 and 3. Command and telemetry links will use QPSK modulation having emission designators of 8KOG1D in C-band and 4KOGID in Ku-band. ELLIPSO™ Command and Telemetry facilities will be collocated with one of the ELLIPSO™ Ground Control Station (GCS) sites in CONUS and, for system robustness, with one or more GCSs overseas.

- Figures 4 and 5 illustrate the satellite forward and return path payload configurations and replace Figures A-1 and A-2 of the November 1994 Amendment.

- Tables 1 and 2 present the center frequencies of each transponder in the forward and return directions.

- Figures 6 through 10 illustrate power contours representative of the specified satellite antenna individual beam patterns and replace Figures A-3 through A-7 in the November 1994 Amendment. Since the S-band transmit and L-band receive antennas are duplicates of each other scaled for frequency, the figures apply to both transmit S-band and receive L-band antennas. These figures reflect minor adjustments to optimize coverage. Otherwise, the ELLIPSO™ satellite user link satellite antenna designs remain unchanged.

- Figure 11 illustrates the power contours of the earth coverage feeder link antennas out to a scan angle of 50 degrees from nadir (the earth subtends only 26.5 degrees nadir to edge from 7846 kilometers attitude). Uplink and downlink antennas have identical patterns. As noted above, MCHI has simplified its feeder link antennas to facilitate reduced feeder link bandwidth occupancy by eliminating the elliptically-shaped sector antennas retaining only the earth coverage feeder link antennas. All user link beams are mapped to channels carried by the earth coverage feeder link antennas.

- ELLIPSO will use code division multiple access (CDMA) for carrying multiple signals within each channel and frequency division multiple access (FDMA) for carrying multiple channels within each beam's spectrum. To facilitate intra-service sharing, MCHI has revised its FDMA channel plans to use 2.5 MHz bandwidth channels or multiples thereof. This change will reduce potential interference among MSS licensees. These changes have no further impact on ELLIPSO™ satellite design. ELLIPSO's FDMA user link channels will be arranged as shown in Figures 12 and 13 which replace Figures C-1 through C-3 in the November 1994 Amendment. The specific arrangement of channels used will depend upon the regional service mix, level of demand, and sharing environment and may vary by region.

- ELLIPSO™ satellite transponders will each carry multiple, simultaneous carriers in each of one or two channels within the passband of each transponder. User signals will have RF emission characteristics corresponding to emission designators 625KG1W, 1M25G1W, 2M5G1W, 5M0G1W, or 10M0GlW, depending on user service, loading, and the regional market, chosen in such a way as to minimize interference while maintaining optimum system efficiency.

- MCHI furnishes modified link budgets reflecting the above changes, shown in Tables 3 through 8, which replace Tables E-1 through E-4 in the November 1994 Amendment.

- As shown in the return link budgets in Tables 6, 7, and 8 line 5c, ELLIPSO terminals operate nominally at levels of from -30 to -35 dBw/4kHz. After allowance of power control margins (~10 dB) ELLIPSO™ terminals will operate well below the -15 dBw/4kHz EIRP density level specified in ITU RR 731E. Regardless of operating bandwidth or level of power control, ELLIPSO terminals will at no time exceed the EIRP density levels specified in RR 731E.

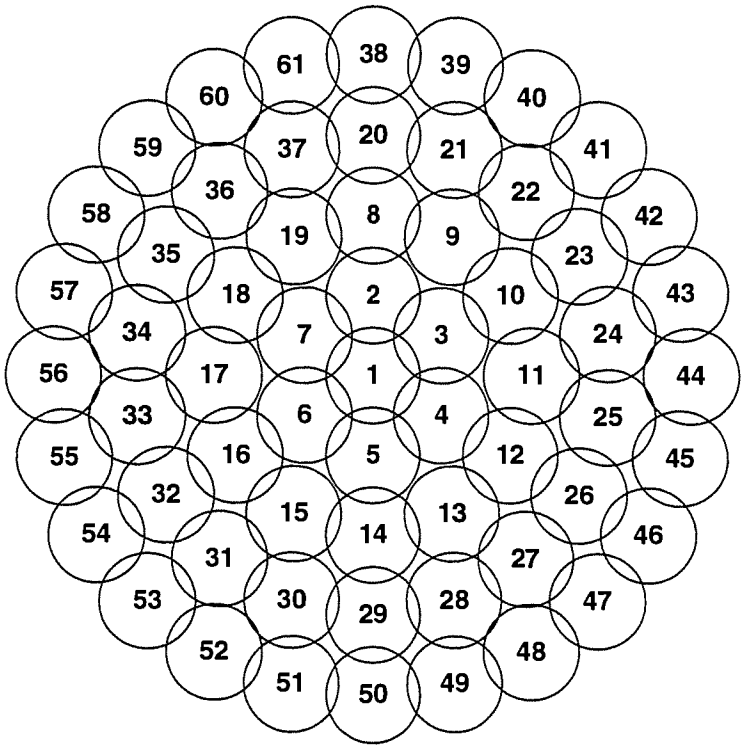


Figure 1
Ellipso User Beam Layout and Numbering

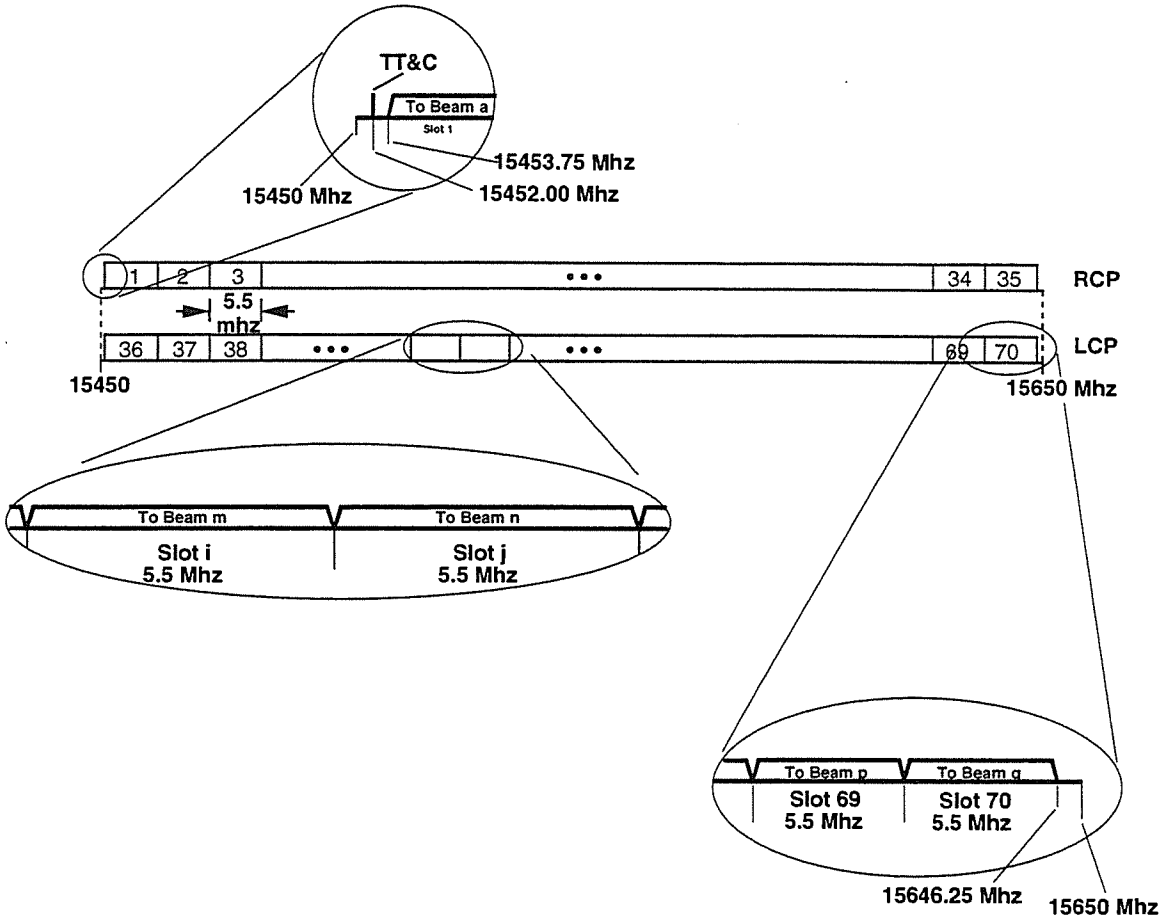


Figure 2
Ku Band Feeder Link Spectral Organization

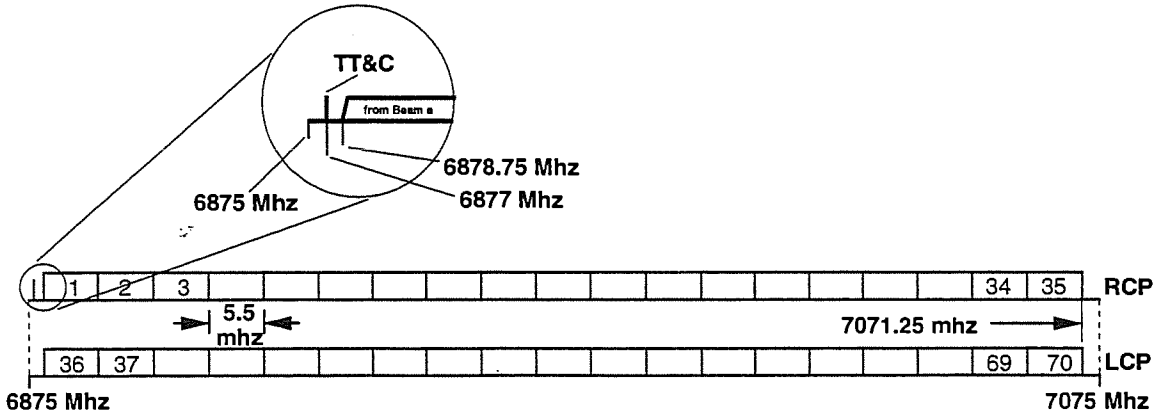


Figure 3
C Band Feeder Link Spectral Organization

- ELLIPSO™ operates within the applicable power flux density hard limits required in Resolution 46 Annex 2. Table 9 presents ELLIPSO's operational C-band PFD levels, the corresponding Resolution 46 C-band PFD hard limits, and the resulting margin by which ELLIPSO operates under these limits. These figures are presented for both Borealis apogee (7846 kilometers) and the lowest operational altitude for Borealis (3,500 kilometers), summing both polarizations. ELLIPSO™ will at all times operate within the ITU PFD limitations. As illustrated in the lower part of Table 9, ELLIPSO™ satellites comply with the PFD limits at the geostationary arc prescribed by Resolution 46.

- Tables 10 and 11 present the ELLIPSO™ Tracking, Telemetry, and Command link budgets and PFD levels respectively.

- Table 12 reflects the anticipated ELLIPSO™ satellite weight budgets, while Table 13 reflects the anticipated ELLIPSO™ satellite power budget. These tables replace Tables A-2 and A-3 in the November 1994 Amendment. Table 14 replaces Table A-3 in the November 1994 Amendment.

- Consistent with these changes, Figure A-10 and Tables A-5 and A-6 are deleted from the November 1994 Amendment.

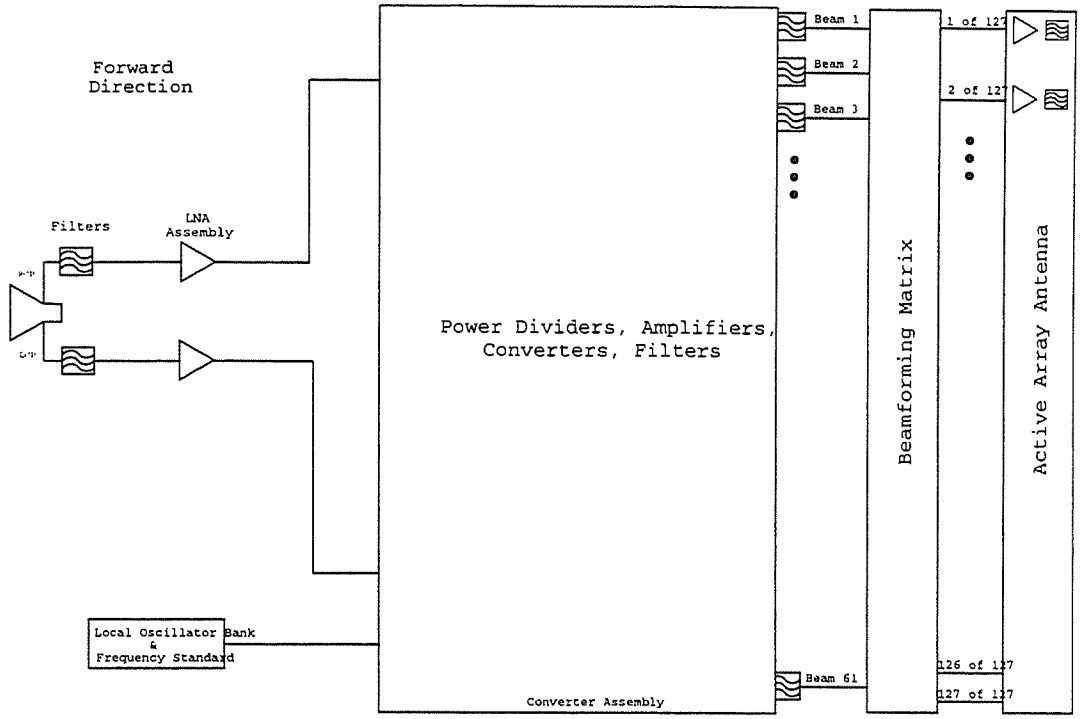


Figure 4
Ellipso Satellite Forward Path Block Diagram

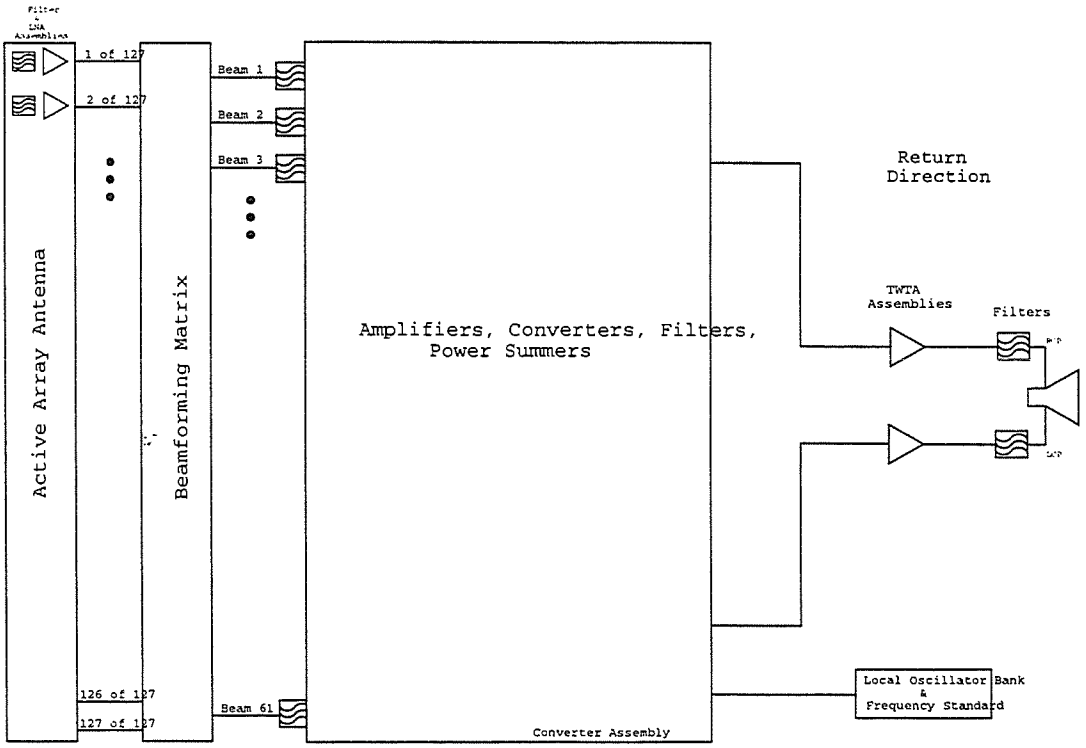


Figure 5
Ellipso Satellite Return Path Block Diagram

Table 1
Satellite Transponder Center Frequencies, Right Hand Polarization

Trans-ponder Channel	Polarizatio	Forward Direction			Return Direction		
		Feeder Link receive Center Frequency Mhz	Bndwdth, mhz	User Link transmit Center Frequency Mhz	User Link receive Center Frequency Mhz	Bndwdth, mhz	Feeder Link transmit Center Frequency Mhz
1	RCP	15,456.50	5.0	2486.25, 2491.75, or 2497.25	1612.75, 1618.25, or 1623.75	5.0	6,881.50
2		15,462.00	5.0	same	same	5.0	6,887.00
3		15,467.50	5.0	same	same	5.0	6,892.50
4		15,473.00	5.0	same	same	5.0	6,898.00
5		15,478.50	5.0	same	same	5.0	6,903.50
6		15,484.00	5.0	same	same	5.0	6,909.00
7		15,489.50	5.0	same	same	5.0	6,914.50
8		15,495.00	5.0	same	same	5.0	6,920.00
9		15,500.50	5.0	same	same	5.0	6,925.50
10		15,506.00	5.0	same	same	5.0	6,931.00
11		15,511.50	5.0	same	same	5.0	6,936.50
12		15,517.00	5.0	same	same	5.0	6,942.00
13		15,522.50	5.0	same	same	5.0	6,947.50
14		15,528.00	5.0	same	same	5.0	6,953.00
15		15,533.50	5.0	same	same	5.0	6,958.50
16		15,539.00	5.0	same	same	5.0	6,964.00
17		15,544.50	5.0	same	same	5.0	6,969.50
18		15,550.00	5.0	same	same	5.0	6,975.00
19		15,555.50	5.0	same	same	5.0	6,980.50
20		15,561.00	5.0	same	same	5.0	6,986.00
21		15,566.50	5.0	same	same	5.0	6,991.50
22		15,572.00	5.0	same	same	5.0	6,997.00
23		15,577.50	5.0	same	same	5.0	7,002.50
24		15,583.00	5.0	same	same	5.0	7,008.00
25		15,588.50	5.0	same	same	5.0	7,013.50
26		15,594.00	5.0	same	same	5.0	7,019.00
27		15,599.50	5.0	same	same	5.0	7,024.50
28		15,605.00	5.0	same	same	5.0	7,030.00
29		15,610.50	5.0	same	same	5.0	7,035.50
30		15,616.00	5.0	same	same	5.0	7,041.00
31		15,621.50	5.0	same	same	5.0	7,046.50
32		15,627.00	5.0	same	same	5.0	7,052.00
33		15,632.50	5.0	same	same	5.0	7,057.50
34		15,638.00	5.0	same	same	5.0	7,063.00
35		15,643.50	5.0	same	same	5.0	7,068.50

Table 2
Satellite Transponder Center Frequencies, Left Hand Polarization

Trans-ponder Channel	Polarizatio	Forward Direction			Return Direction		
		Feeder Link receive Center Frequency Mhz	Bndwdth, mhz	User Link transmit Center Frequency Mhz	User Link receive Center Frequency Mhz	Bndwdth, mhz	Feeder Link transmit Center Frequency Mhz
36		15,456.50	5.0	2486.25, 2491.75, or 2497.25	1612.75, 1618.25, or 1623.75	5.0	6,881.50
37		15,462.00	5.0	same	same	5.0	6,887.00
38		15,467.50	5.0	same	same	5.0	6,892.50
39		15,473.00	5.0	same	same	5.0	6,898.00
40		15,478.50	5.0	same	same	5.0	6,903.50
41		15,484.00	5.0	same	same	5.0	6,909.00
42		15,489.50	5.0	same	same	5.0	6,914.50
43		15,495.00	5.0	same	same	5.0	6,920.00
44		15,500.50	5.0	same	same	5.0	6,925.50
45		15,506.00	5.0	same	same	5.0	6,931.00
46		15,511.50	5.0	same	same	5.0	6,936.50
47		15,517.00	5.0	same	same	5.0	6,942.00
48		15,522.50	5.0	same	same	5.0	6,947.50
49		15,528.00	5.0	same	same	5.0	6,953.00
50		15,533.50	5.0	same	same	5.0	6,958.50
51	LCP	15,539.00	5.0	same	same	5.0	6,964.00
52		15,544.50	5.0	same	same	5.0	6,969.50
53		15,550.00	5.0	same	same	5.0	6,975.00
54		15,555.50	5.0	same	same	5.0	6,980.50
55		15,561.00	5.0	same	same	5.0	6,986.00
56		15,566.50	5.0	same	same	5.0	6,991.50
57		15,572.00	5.0	same	same	5.0	6,997.00
58		15,577.50	5.0	same	same	5.0	7,002.50
59		15,583.00	5.0	same	same	5.0	7,008.00
60		15,588.50	5.0	same	same	5.0	7,013.50
61		15,594.00	5.0	same	same	5.0	7,019.00
62		15,599.50	5.0	same	same	5.0	7,024.50
63		15,605.00	5.0	same	same	5.0	7,030.00
64		15,610.50	5.0	same	same	5.0	7,035.50
65		15,616.00	5.0	same	same	5.0	7,041.00
66		15,621.50	5.0	same	same	5.0	7,046.50
67		15,627.00	5.0	same	same	5.0	7,052.00
68		15,632.50	5.0	same	same	5.0	7,057.50
69		15,638.00	5.0	same	same	5.0	7,063.00
70		15,643.50	5.0	same	same	5.0	7,068.50

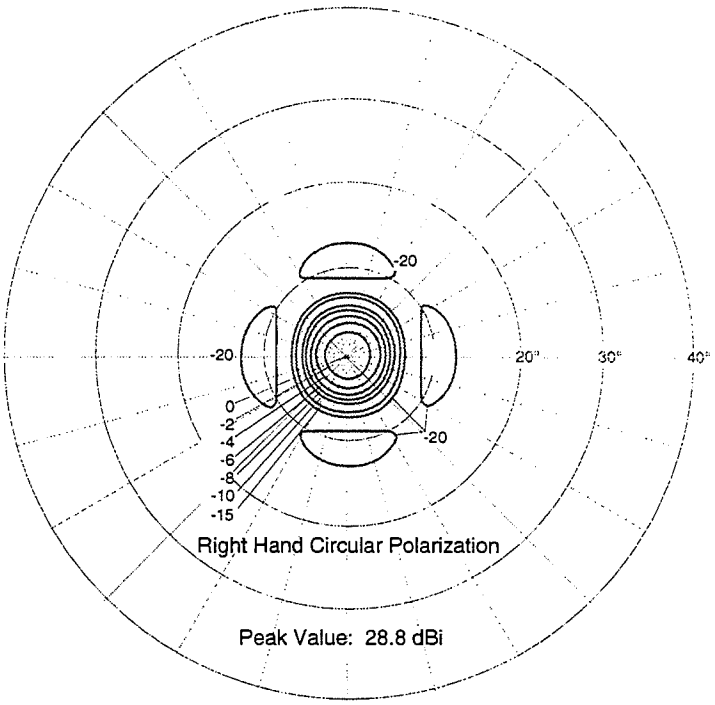


Figure 6
Ellipso Center Beam Gain Contours

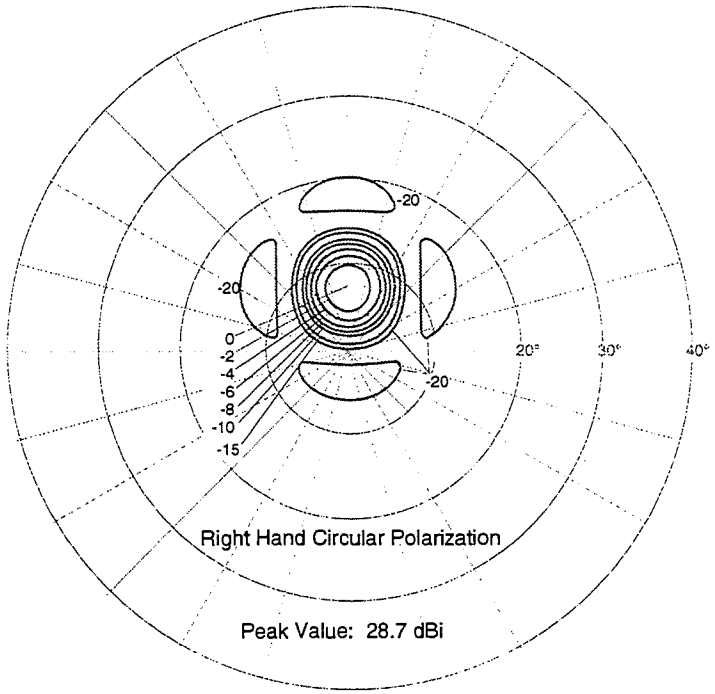


Figure 7
Gain Contour for Beam in First Ring

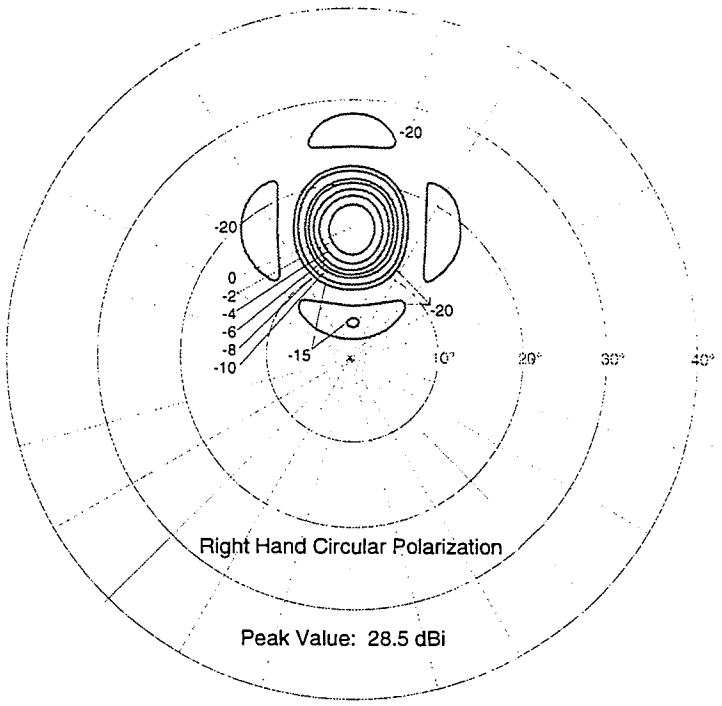


Figure 8
Gain Contour for Beam in Second Ring

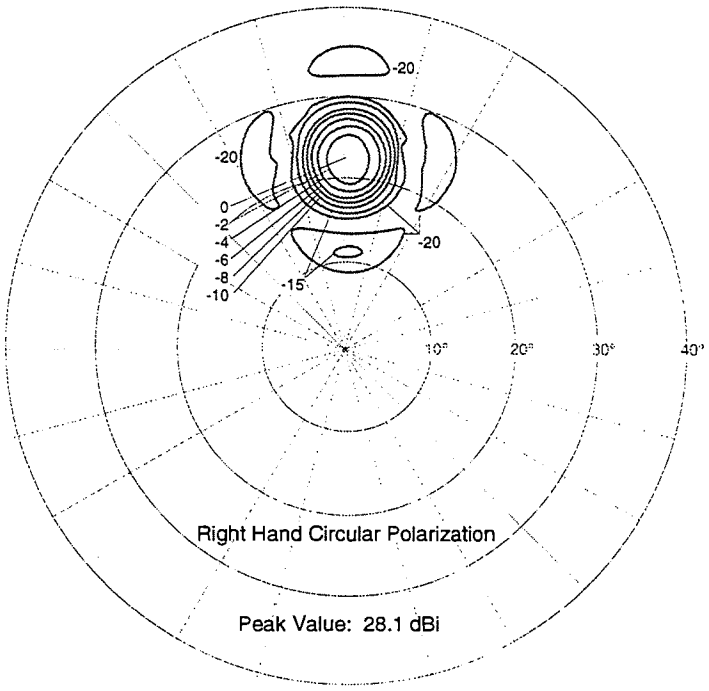


Figure 9
Gain Contour for Beam in Third Ring

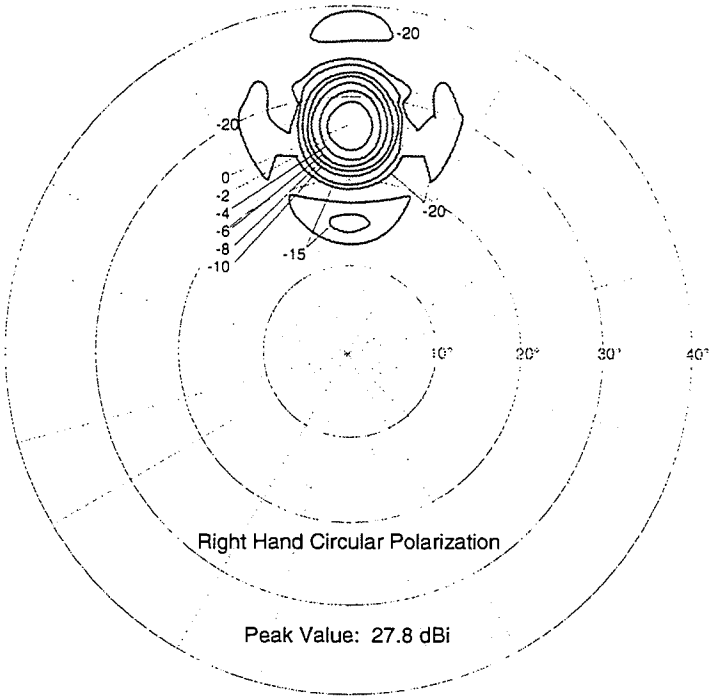


Figure 10
Gain Contour for Beam in Fourth Ring

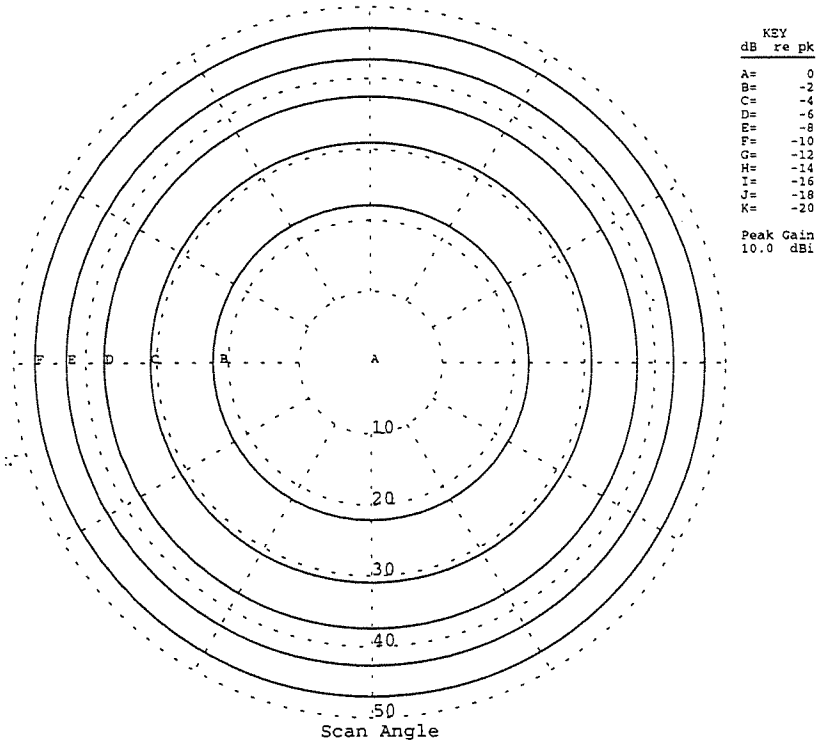


Figure 11
Feeder Link Beam Contours, Up and Downlinks

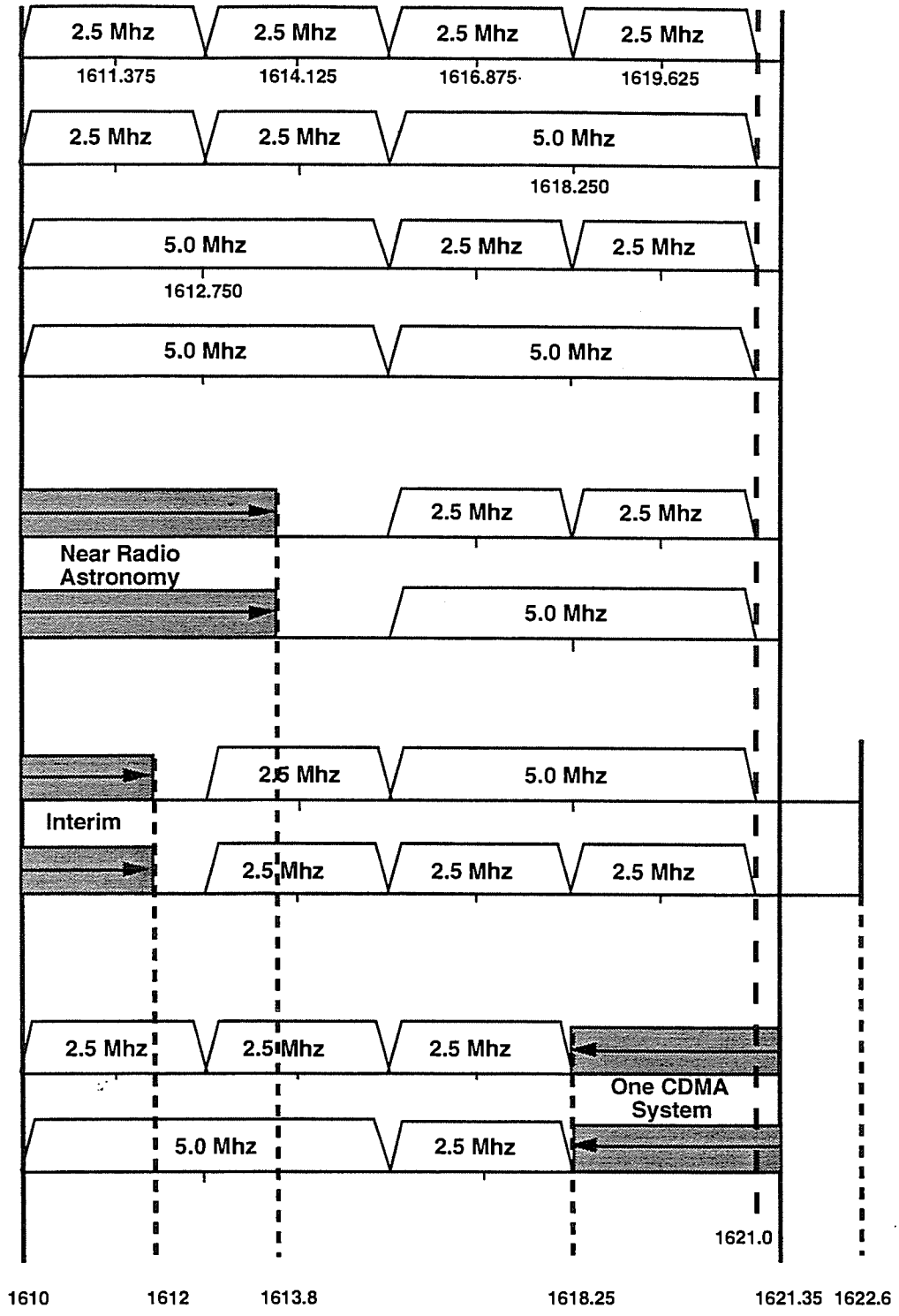


Figure 12
Ellipso Channel Plan at L-Band
Frequencies in Megahertz, Right Hand Circular Polarization

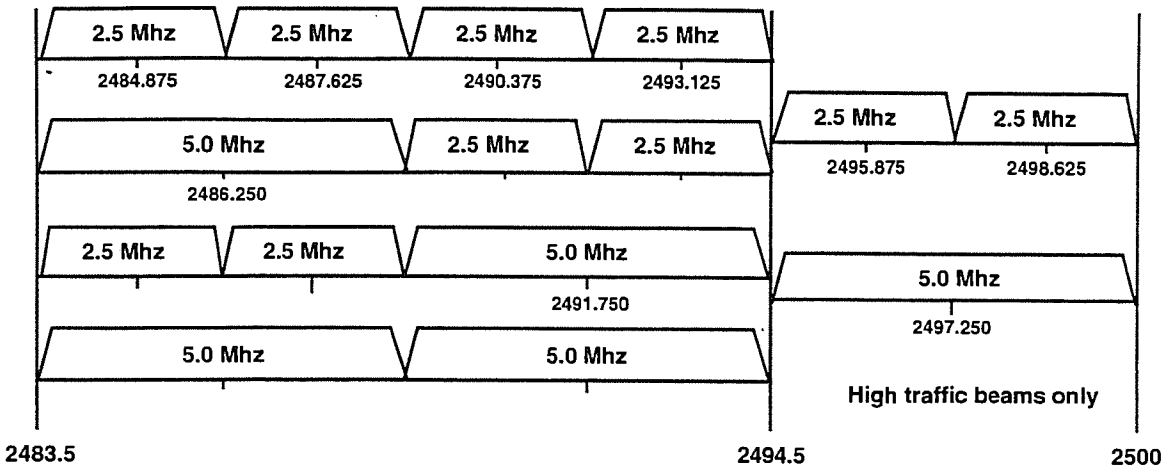


Figure 13
Ellipso Channel Plan at S-Band
Frequencies in Megahertz, Right Hand Circular Polarization

Table 3
Forward Link Calculations, Wide Band Channel
Mobile/Handheld Example

Item	Parameter	Unit	Center	1st Ring	2nd Ring	3rd Ring	4th Ring
	GENERAL						
2	Data Rate	bps	4800	4800	4800	4800	4800
3	RF Bandwidth	MHz	5.00	5.00	5.00	5.00	5.00
	UPLINK						
4	Frequency	MHz	15550	15550	15550	15550	15550
5	EIRP/carrier	dBW	45.55	46.77	48.85	52.72	56.51
5a	Transmit Power/carrier	W	0.11	0.14	0.23	0.55	1.32
5b	Transmit Antenna Gain (4.5 m)	dBi	55.3	55.3	55.3	55.3	55.3
6	Free Space Loss	dB	-194.28	-194.62	-195.27	-196.54	-197.60
6a	Range	km	7944	8262	8906	10310	11649
7	Atmospheric Losses	dB	0.50	0.50	0.50	0.50	0.50
8	Receive Antenna Gain	dBi	10.00	9.80	9.50	8.80	8.00
9	Received Power/carrier	dBW	-139.23	-138.55	-137.42	-135.52	-133.59
10	Thermal Noise Density	dBW/Hz	-200.82	-200.82	-200.82	-200.82	-200.82
10a	Receiver Temperature	°K	600	600	600	600	600
11	Thermal Noise Power	dBW	-133.83	-133.83	-133.83	-133.83	-133.83
12	Uplink Signal to Noise Ratio (S/N)	dB	-5.40	-4.72	-3.59	-1.69	0.23
13	Transponder gain	dB	132.00	132.00	132.00	132.00	132.00
14a	**DOWNLINK**						
14b	Frequency	MHz	2490	2490	2490	2490	2490
15	EIRP/Carrier	dBW	21.52	22.13	23.06	24.62	26.22
15a	Net Signal Xmit Pwr/carrier	W	0.19	0.22	0.29	0.44	0.69
15b	Transmission line loss	dB	0.50	0.50	0.50	0.50	0.50
15c	Transmitter Power/carrier	w	0.21	0.25	0.32	0.50	0.78
15d	Transmit Antenna Gain	dBi	28.75	28.68	28.48	28.14	27.81
15f	EIRP in beam	dBw	37.96	38.30	38.96	40.23	41.29
16	Free Space Loss	dB	-178.37	-178.71	-179.36	-180.63	-181.69
16a	Range	km	7944	8262	8906	10310	11649
17	XS Path Loss	dB	0.1	0.1	0.1	0.2	0.2
18	Receive antenna gain	dBi	1.00	1.40	1.80	2.00	1.00
19	Power Control Margin	dB	1.00	1.50	2.00	2.40	2.40
20	Received signal power	dBW	-156.94	-156.77	-156.60	-156.61	-157.08
21	Thermal Noise spectral density	dBW/Hz	-203.16	-203.16	-203.16	-203.16	-203.16
21a	User Term Rcvr Temp	°K	350	350	350	350	350
22	Thermal Noise Power	dBW	-136.17	-136.17	-136.17	-136.17	-136.17
23	Downlink Signal to Noise Ratio (S/N)	dB	-20.78	-20.60	-20.43	-20.44	-20.91
	INTERFERENCE						
25	Self Interference Spectral Density	dBW/Hz	-216.39	-215.99	-215.59	-215.39	-216.39
25a	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
25b	Interference Factor Within Beam		0.00	0.00	0.00	0.00	0.00
25c	Interference Factor For Adjacent Beams		0.10	0.10	0.10	0.10	0.10
26	Interference Density From Other Ellipsos	dBW/Hz	-206.39	-205.99	-205.59	-205.39	-206.39
26a	Number of other Ellipso satellites		1.00	1.00	1.00	1.00	1.00
26b	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
26c	Interference Factor		1.00	1.00	1.00	1.00	1.00
27	Interference Density From Other Systems	dBW/Hz	-209.40	-209.00	-208.60	-208.40	-209.40
27a	Number of satellites		2	2	2	2	2
27b	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
27c	Interference Factor (X-pol)		0.250	0.250	0.250	0.250	0.250
28	Total Interference Spectral Density	dBW/Hz	-204.35	-203.95	-203.55	-203.35	-204.35
29	Total Interference Power	dBW	-137.36	-136.96	-136.56	-136.36	-137.36
30	Downlink Signal to Interference Ratio (S/IF)	dB	-19.58	-19.81	-20.03	-20.25	-19.71
	INTERMODULATION						
31	Downlink Carrier to Intermodulation Ratio (C/IM)	dB	18	18	18	18	18
32	Downlink Signal to Intermodulation Ratio (S/IM)	dB	1.56	1.83	2.11	2.40	2.93
	LINK PERFORMANCE						
33	Composite Signal to Noise Ratio (S/N+IF+IM)	dB	-23.31	-23.31	-23.30	-23.39	-23.39
34	Processing Gain	dB	30.18	30.18	30.18	30.18	30.18
35	Received Eb/No	dB	6.86	6.87	6.87	6.78	6.79
36	Required Eb/No	dB	3.00	3.00	3.00	3.00	3.00
37	**Margin**	dB	**3.9**	**3.9**	**3.9**	**3.8**	**3.8**
38	**Additional Margin w/ Power Control**	dB	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**

Table 4
Forward Link Calculations, Narrow Band Channel
Fixed Terminal Example

Item	Parameter	Unit	Center	1st Ring	2nd Ring	3rd Ring	4th Ring
	GENERAL						
2	Data Rate	bps	4800	4800	4800	4800	4800
3	RF Bandwidth	MHz	2.50	2.50	2.50	2.50	2.50
	UPLINK						
4	Frequency	MHz	15550	15550	15550	15550	15550
5	EIRP/carrier	dBW	37.79	38.78	40.64	44.31	47.61
5a	Transmit Power/carrier	W	0.02	0.02	0.03	0.08	0.17
5b	Transmit Antenna Gain (4.5 m)	dBi	55.3	55.3	55.3	55.3	55.3
6	Free Space Loss	dB	-194.28	-194.62	-195.27	-196.54	-197.60
6a	Range	km	7944	8262	8906	10310	11649
7	Atmospheric Losses	dB	0.50	0.50	0.50	0.50	0.50
8	Receive Antenna Gain	dBi	10.00	9.80	9.50	8.80	8.00
9	Received Power/carrier	dBW	-146.99	-146.54	-145.63	-143.93	-142.49
10	Thermal Noise Density	dBW/Hz	-200.82	-200.82	-200.82	-200.82	-200.82
10a	Receiver Temperature	°K	600	600	600	600	600
11	Thermal Noise Power	dBW	-136.84	-136.84	-136.84	-136.84	-136.84
12	Uplink Signal to Noise Ratio (S/N)	dB	-10.15	-9.70	-8.79	-7.09	-5.65
13	Transponder gain	dB	132.00	132.00	132.00	132.00	132.00
14a	**DOWNLINK**						
14b	Frequency	MHz	2490	2490	2490	2490	2490
15	EIRP/Carrier	dBW	13.76	14.14	14.85	16.21	17.32
15a	Net Signal Xmit Pwr/carrier	W	0.03	0.04	0.04	0.06	0.09
15b	Transmission line loss	dB	0.50	0.50	0.50	0.50	0.50
15c	Transmitter Power/carrier	w	0.04	0.04	0.05	0.07	0.10
15d	Transmit Antenna Gain	dBi	28.75	28.68	28.48	28.14	27.81
15f	EIRP in beam	dBw	34.95	35.29	35.94	37.22	38.28
16	Free Space Loss	dB	-178.37	-178.71	-179.36	-180.63	-181.69
16a	Range	km	7944	8262	8906	10310	11649
17	XS Path Loss	dB	0.1	0.1	0.1	0.2	0.2
18	Receive antenna gain	dBi	10.00	10.00	10.00	10.00	10.00
19	Power Control Margin	dB	0.00	0.00	0.00	0.00	0.00
20	Received signal power	dBW	-154.70	-154.67	-154.61	-154.62	-154.57
21	Thermal Noise spectral density	dBW/Hz	-205.59	-205.59	-205.59	-205.59	-205.59
21a	User Term Rcvr Temp	°K	200	200	200	200	200
22	Thermal Noise Power	dBW	-141.61	-141.61	-141.61	-141.61	-141.61
23	Downlink Signal to Noise Ratio (S/N)	dB	-13.09	-13.06	-13.00	-13.01	-12.96
	INTERFERENCE						
25	Self Interference Spectral Density	dBW/Hz	-207.39	-207.39	-207.39	-207.39	-207.39
25a	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
25b	Interference Factor Within Beam		0.00	0.00	0.00	0.00	0.00
25c	Interference Factor For Adjacent Beams		0.10	0.10	0.10	0.10	0.10
26	Interference Density From Other Ellipsos	dBW/Hz	-203.41	-203.41	-203.41	-203.41	-203.41
26a	Number of other Ellipso satellites		1.00	1.00	1.00	1.00	1.00
26b	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
26c	Interference Factor		0.25	0.25	0.25	0.25	0.25
27	Interference Density From Other Systems	dBW/Hz	-202.45	-202.45	-202.45	-202.45	-202.45
27a	Number of satellites		2	2	2	2	2
27b	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
27c	Interference Factor (X-pol)		0.156	0.156	0.156	0.156	0.156
28	Total Interference Spectral Density	dBW/Hz	-199.18	-199.18	-199.18	-199.18	-199.18
29	Total Interference Power	dBW	-135.20	-135.20	-135.20	-135.20	-135.20
30	Downlink Signal to Interference Ratio (S/IF)	dB	-19.50	-19.46	-19.40	-19.42	-19.37
	INTERMODULATION						
31	Downlink Carrier to Intermodulation Ratio (C/IM)	dB	18	18	18	18	18
32	Downlink Signal to Intermodulation Ratio (S/IM)	dB	-3.19	-3.15	-3.09	-3.01	-2.96
	LINK PERFORMANCE						
33	Composite Signal to Noise Ratio (S/N+IF+IM)	dB	-20.86	-20.79	-20.67	-20.59	-20.49
34	Processing Gain	dB	27.17	27.17	27.17	27.17	27.17
35	Received Eb/No	dB	6.31	6.37	6.50	6.57	6.68
36	Required Eb/No	dB	3.00	3.00	3.00	3.00	3.00
37	**Margin**	dB	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**
38	**Additional Margin w/ Power Control**	dB	**None Required**				

Table 5
Forward Link Calculations, Narrow Band Channel
Mobile/Handheld Terminal Example

Item	Parameter	Unit	Center	1st Ring	2nd Ring	3rd Ring	4th Ring
	GENERAL						
2	Data Rate	bps	4800	4800	4800	4800	4800
3	RF Bandwidth	MHz	2.50	2.50	2.50	2.50	2.50
	UPLINK						
4	Frequency	MHz	15550	15550	15550	15550	15550
5	EIRP/carrier	dBW	45.55	46.77	48.85	52.72	56.51
5a	Transmit Power/carrier	W	0.11	0.14	0.23	0.55	1.32
5b	Transmit Antenna Gain (4.5 m)	dBi	55.3	55.3	55.3	55.3	55.3
6	Free Space Loss	dB	-194.28	-194.62	-195.27	-196.54	-197.60
6a	Range	km	7944	8262	8906	10310	11649
7	Atmospheric Losses	dB	0.50	0.50	0.50	0.50	0.50
8	Receive Antenna Gain	dBi	10.00	9.80	9.50	8.80	8.00
9	Received Power/carrier	dBW	-139.23	-138.55	-137.42	-135.52	-133.59
10	Thermal Noise Density	dBW/Hz	-200.82	-200.82	-200.82	-200.82	-200.82
10a	Receiver Temperature	°K	600	600	600	600	600
11	Thermal Noise Power	dBW	-136.84	-136.84	-136.84	-136.84	-136.84
12	Uplink Signal to Noise Ratio (S/N)	dB	-2.39	-1.71	-0.58	1.32	3.24
13	Transponder gain	dB	132.00	132.00	132.00	132.00	132.00
14a	**DOWNLINK**						
14b	Frequency	MHz	2490	2490	2490	2490	2490
15	EIRP/Carrier	dBW	21.52	22.13	23.06	24.62	26.22
15a	Net Signal Xmit Pwr/carrier	W	0.19	0.22	0.29	0.44	0.69
15b	Transmission line loss	dB	0.50	0.50	0.50	0.50	0.50
15c	Transmitter Power/carrier	w	0.21	0.25	0.32	0.50	0.78
15d	Transmit Antenna Gain	dBi	28.75	28.68	28.48	28.14	27.81
15f	EIRP in beam	dBw	34.95	35.29	35.94	37.22	38.28
16	Free Space Loss	dB	-178.37	-178.71	-179.36	-180.63	-181.69
16a	Range	km	7944	8262	8906	10310	11649
17	XS Path Loss	dB	0.1	0.1	0.1	0.2	0.2
18	Receive antenna gain	dBi	1.00	1.40	1.80	2.00	1.00
19	Power Control Margin	dB	1.00	1.50	2.00	2.40	2.40
20	Received signal power	dBW	-156.94	-156.77	-156.60	-156.61	-157.08
21	Thermal Noise spectral density	dBW/Hz	-203.16	-203.16	-203.16	-203.16	-203.16
21a	User Term Rcvr Temp	°K	350	350	350	350	350
22	Thermal Noise Power	dBW	-139.18	-139.18	-139.18	-139.18	-139.18
23	Downlink Signal to Noise Ratio (S/N)	dB	-17.76	-17.59	-17.42	-17.43	-17.90
	INTERFERENCE						
25	Self Interference Spectral Density	dBW/Hz	-216.39	-215.99	-215.59	-215.39	-216.39
25a	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
25b	Interference Factor Within Beam		0.00	0.00	0.00	0.00	0.00
25c	Interference Factor For Adjacent Beams		0.10	0.10	0.10	0.10	0.10
26	Interference Density From Other Ellipsos	dBW/Hz	-206.39	-205.99	-205.59	-205.39	-206.39
26a	Number of other Ellipso satellites		1.00	1.00	1.00	1.00	1.00
26b	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
26c	Interference Factor		1.00	1.00	1.00	1.00	1.00
27	Interference Density From Other Systems	dBW/Hz	-209.40	-209.00	-208.60	-208.40	-209.40
27a	Number of satellites		2	2	2	2	2
27b	Interference PFD (4 kHz)	dBW/m^2	-142	-142	-142	-142	-142
27c	Interference Factor (X-pol)		0.250	0.250	0.250	0.250	0.250
28	Total Interference Spectral Density	dBW/Hz	-204.35	-203.95	-203.55	-203.35	-204.35
29	Total Interference Power	dBW	-140.37	-139.97	-139.57	-139.37	-140.37
30	Downlink Signal to Interference Ratio (S/IF)	dB	-16.57	-16.80	-17.02	-17.24	-16.70
	INTERMODULATION						
31	Downlink Carrier to Intermodulation Ratio (C/IM)	dB	18	18	18	18	18
32	Downlink Signal to Intermodulation Ratio (S/IM)	dB	4.57	4.84	5.12	5.41	5.94
	LINK PERFORMANCE						
33	Composite Signal to Noise Ratio (S/N+IF+IM)	dB	-20.30	-20.30	-20.29	-20.38	-20.38
34	Processing Gain	dB	27.17	27.17	27.17	27.17	27.17
35	Received Eb/No	dB	6.86	6.87	6.87	6.78	6.79
36	Required Eb/No	dB	3.00	3.00	3.00	3.00	3.00
37	**Margin**	dB	**3.9**	**3.9**	**3.9**	**3.8**	**3.8**
38	**Additional Margin w/ Power Control**	dB	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**

Table 6
Return Link Calculations, Wide Band Channel
Mobile/Handheld Terminal Example

Item	Parameter	Unit	Center	1st Ring	2nd Ring	3rd Ring	4th Ring
	GENERAL						
2	Data Rate	bps	4800	4800	4800	4800	4800
3	RF Bandwidth	MHz	5.00	5.00	5.00	5.00	5.00
	UPLINK						
4	Frequency	MHz	1620	1620	1620	1620	1620
5	EIRP/Carrier	dBW	-5.02	-4.62	-4.22	-3.23	-3.32
5a	Transmit Power Per Carrier	W	0.25	0.25	0.25	0.30	0.37
5b	Transmit Antenna Gain	dBi	1.00	1.40	1.80	2.00	1.00
5c	Tramsmit EIRP Density/4 khz	dBw/4khz	-35.99	-35.59	-35.19	-34.20	-34.29
6	Free Space Loss	dB	-174.63	-174.97	-175.63	-176.90	-177.96
6a	Range	km	7944	8262	8906	10310	11649
7	Excess Path Loss	dB	0.1	0.1	0.1	0.2	0.2
7	Receive Antenna Gain	dBi	27.25	27.18	26.98	26.64	26.31
8	Received Power	dBW	-152.40	-152.41	-152.87	-153.49	-154.97
9	Thermal Noise Density	dBW/Hz	-201.85	-201.85	-201.85	-201.85	-201.85
9a	Receiver Temperature	K	473	473	473	473	473
10	Thermal Noise Power	dBW	-134.86	-134.86	-134.86	-134.86	-134.86
11	Uplink Signal to Noise Ratio (S/N)	dB	-17.54	-17.55	-18.00	-18.62	-20.10
11a	Transponder gain	dB	132.00	132.00	132.00	132.00	132.00
	DOWNLINK						
12	Frequency	MHz	6975	6975	6975	6975	6975
13	EIRP/carrier	dBW	-10.40	-10.61	-11.37	-12.69	-14.97
13a	Transmit Antenna Gain	dBi	10.00	9.80	9.50	8.80	8.00
13b	Total Power Transmitted per beam	w	2.46	2.35	2.09	1.82	1.35
13c	Transmission Line Loss	dB	0.80	0.80	0.80	0.80	0.80
13d	Transmit Signal Power Per Carrier	w	0.0091	0.0091	0.0082	0.0071	0.0051
13e	Total Power to Interference & Noise	w	1.91	1.83	1.65	1.45	1.12
15	Free Space Loss	dB	-187.31	-187.65	-188.31	-189.58	-190.64
15a	Range	km	7944	8262	8906	10310	11649
16	Atmospheric Losses	dB	1.00	1.00	1.00	1.00	1.00
17	Receive Antenna Gain	dBi	48.3	48.3	48.3	48.3	48.3
18	Received Signal Power	dBW	-150.38	-150.93	-152.34	-154.93	-158.27
19	Thermal Noise spectral density	dBW/Hz	-206.84	-206.84	-206.84	-206.84	-206.84
19	Receiver Temperature	K	150	150	150	150	150
20	Thermal Noise Power	dBW	-139.85	-139.85	-139.85	-139.85	-139.85
21	Downlink Signal to Noise Ratio (S/N)	dB	-10.53	-11.08	-12.49	-15.08	-18.42
	INTERFERENCE						
22a	Interf Factor For In-beam Channels		1.0	1.0	1.0	1.0	1.0
22b	Interf Factor For Adj Beam Channels		0.5	0.5	0.5	0.5	0.5
22c	Interference Factor oth Ell sats		1.0	1.0	1.0	1.0	1.0
22d	IF-Oth Sys (incl X-pol & ant discr if any)		0.25	0.25	0.25	0.25	0.25
23	Uplink Signal to Interference Ratio (S/IF)	dB	-21.75	-21.51	-21.29	-21.09	-20.61
	INTERMODULATION						
24	Downlink Carrier to Intermodulation Ratio (C/IM)	dB	18	18	18	18	18
25	Downlink Signal to Intermodulation Ratio (S/IM)	dB	-5.98	-5.80	-5.76	-5.79	-6.02
	LINK PERFORMANCE						
26	Composite Signal to Noise Ratio (S/N+IF+IM)	dB	-23.46	-23.33	-23.41	-23.76	-24.64
27	Processing Gain	dB	30.18	30.18	30.18	30.18	30.18
28	Received Eb/No	dB	6.72	6.85	6.77	6.42	5.54
29	Required Eb/No	dB	3.00	3.00	3.00	3.00	3.00
30	**Margin**	**dB**	**3.7**	**3.8**	**3.8**	**3.4**	**2.5**
31	**Additional Margin for Power Control**	**dB**	**10**	**10**	**10**	**10**	**10**

Table 7
Return Link Calculations, Narrow Band Channel
Fixed Terminal Example

Item	Parameter	Unit	Center	1st Ring	2nd Ring	3rd Ring	4th Ring
	GENERAL						
2	Data Rate	bps	4800	4800	4800	4800	4800
3	RF Bandwidth	MHz	2.50	2.50	2.50	2.50	2.50
	UPLINK						
4	Frequency	MHz	1620	1620	1620	1620	1620
5	EIRP/Carrier	dBW	-3.01	-3.01	-1.55	1.46	1.46
5a	Transmit Power Per Carrier	W	0.050	0.050	0.070	0.140	0.140
5b	Transmit Antenna Gain	dBi	10.00	10.00	10.00	10.00	10.00
5c	Tramsmit EIRP Density/4 khz	dBw/4khz	-30.97	-30.97	-29.51	-26.50	-26.50
6	Free Space Loss	dB	-174.63	-174.97	-175.63	-176.90	-177.96
6a	Range	km	7944	8262	8906	10310	11649
7	Excess Path Loss	dB	0.1	0.1	0.1	0.2	0.2
7	Receive Antenna Gain	dBi	27.25	27.18	26.98	26.64	26.31
8	Received Power	dBW	-150.39	-150.80	-150.20	-148.80	-150.19
9	Thermal Noise Density	dBW/Hz	-201.85	-201.85	-201.85	-201.85	-201.85
9a	Receiver Temperature	K	473	473	473	473	473
10	Thermal Noise Power	dBW	-137.87	-137.87	-137.87	-137.87	-137.87
11	Uplink Signal to Noise Ratio (S/N)	dB	-12.52	-12.93	-12.32	-10.92	-12.31
11a	Transponder gain	dB	132.00	132.00	132.00	132.00	132.00
	DOWNLINK						
12	Frequency	MHz	6975	6975	6975	6975	6975
13	EIRP/carrier	dBW	-8.39	-9.00	-8.70	-8.00	-10.19
13a	Transmit Antenna Gain	dBi	10.00	9.80	9.50	8.80	8.00
13b	Total Power Transmitted per beam	w	1.92	2.50	3.69	6.10	4.50
13c	Transmission Line Loss	dB	0.80	0.80	0.80	0.80	0.80
13d	Transmit Signal Power Per Carrier	w	0.0145	0.0132	0.0152	0.0209	0.0152
13e	Total Power to Interference & Noise	w	1.28	1.63	2.36	3.83	2.85
15	Free Space Loss	dB	-187.31	-187.65	-188.31	-189.58	-190.64
15a	Range	km	7944	8262	8906	10310	11649
16	Atmospheric Losses	dB	1.00	1.00	1.00	1.00	1.00
17	Receive Antenna Gain	dBi	48.3	48.3	48.3	48.3	48.3
18	Received Signal Power	dBW	-148.37	-149.32	-149.67	-150.24	-153.49
19	Thermal Noise spectral density	dBW/Hz	-206.84	-206.84	-206.84	-206.84	-206.84
19	Receiver Temperature	K	150	150	150	150	150
20	Thermal Noise Power	dBW	-142.86	-142.86	-142.86	-142.86	-142.86
21	Downlink Signal to Noise Ratio (S/N)	dB	-5.51	-6.46	-6.81	-7.38	-10.63
	INTERFERENCE						
22a	Interf Factor For In-beam Channels		1.0	1.0	1.0	1.0	1.0
22b	Interf Factor For Adj Beam Channels		0.5	0.5	0.5	0.5	0.5
22c	Interference Factor oth Ell sats		0.3	0.3	0.3	0.3	0.3
22d	IF-Oth Sys (incl X-pol & ant discr if any)		0.16	0.16	0.16	0.16	0.16
23	Uplink Signal to Interference Ratio (S/IF)	dB	-18.38	-20.10	-21.33	-22.25	-22.25
	INTERMODULATION						
24	Downlink Carrier to Intermodulation Ratio (C/IM)	dB	18	18	18	18	18
25	Downlink Signal to Intermodulation Ratio (S/IM)	dB	-2.72	-4.26	-5.31	-6.08	-6.16
	LINK PERFORMANCE						
26	Composite Signal to Noise Ratio (S/N+IF+IM)	dB	-19.64	-21.11	-22.07	-22.78	-23.02
27	Processing Gain	dB	27.17	27.17	27.17	27.17	27.17
28	Received Eb/No	dB	7.52	6.06	5.09	4.39	4.14
29	Required Eb/No	dB	3.00	3.00	3.00	3.00	3.00
30	**Margin**	**dB**	**4.5**	**3.1**	**2.1**	**1.4**	**1.1**
31	**Additional Margin for Power Control**	**dB**	**10**	**10**	**10**	**10**	**10**

Table 8
Return Link Calculations, Narrow Band Channel
Mobile/Handheld Terminal Example

Item	Parameter	Unit	Center	1st Ring	2nd Ring	3rd Ring	3rd Ring
	GENERAL						
2	Data Rate	bps	4800	4800	4800	4800	4800
3	RF Bandwidth	MHz	2.50	2.50	2.50	2.50	2.50
	UPLINK						
4	Frequency	MHz	1620	1620	1620	1620	1620
5	EIRP/Carrier	dBW	-5.02	-4.62	-4.22	-3.23	-3.32
5a	Transmit Power Per Carrier	W	0.25	0.25	0.25	0.30	0.37
5b	Transmit Antenna Gain	dBi	1.00	1.40	1.80	2.00	1.00
5c	Tramsmit EIRP Density/4 khz	dBw/4khz	-32.98	-32.58	-32.18	-31.19	-31.28
6	Free Space Loss	dB	-174.63	-174.97	-175.63	-176.90	-177.96
6a	Range	km	7944	8262	8906	10310	11649
7	Excess Path Loss	dB	0.1	0.1	0.1	0.2	0.2
7	Receive Antenna Gain	dBi	27.25	27.18	26.98	26.64	26.31
8	Received Power	dBW	-152.40	-152.41	-152.87	-153.49	-154.97
9	Thermal Noise Density	dBW/Hz	-201.85	-201.85	-201.85	-201.85	-201.85
9a	Receiver Temperature	K	473	473	473	473	473
10	Thermal Noise Power	dBW	-137.87	-137.87	-137.87	-137.87	-137.87
11	Uplink Signal to Noise Ratio (S/N)	dB	-14.53	-14.54	-14.99	-15.61	-17.09
11a	Transponder gain	dB	132.00	132.00	132.00	132.00	132.00
	DOWNLINK						
12	Frequency	MHz	6975	6975	6975	6975	6975
13	EIRP/carrier	dBW	-10.40	-10.61	-11.37	-12.69	-14.97
13a	Transmit Antenna Gain	dBi	10.00	9.80	9.50	8.80	8.00
13b	Total Power Transmitted per beam	w	1.23	1.18	1.05	0.91	0.68
13c	Transmission Line Loss	dB	0.80	0.80	0.80	0.80	0.80
13d	Transmit Signal Power Per Carrier	w	0.0091	0.0091	0.0082	0.0071	0.0051
13e	Total Power to Interference & Noise	w	0.96	0.92	0.82	0.73	0.56
15	Free Space Loss	dB	-187.31	-187.65	-188.31	-189.58	-190.64
15a	Range	km	7944	8262	8906	10310	11649
16	Atmospheric Losses	dB	1.00	1.00	1.00	1.00	1.00
17	Receive Antenna Gain	dBi	48.3	48.3	48.3	48.3	48.3
18	Received Signal Power	dBW	-150.38	-150.93	-152.34	-154.93	-158.27
19	Thermal Noise spectral density	dBW/Hz	-206.84	-206.84	-206.84	-206.84	-206.84
19	Receiver Temperature	K	150	150	150	150	150
20	Thermal Noise Power	dBW	-142.86	-142.86	-142.86	-142.86	-142.86
21	Downlink Signal to Noise Ratio (S/N)	dB	-7.52	-8.07	-9.48	-12.07	-15.41
	INTERFERENCE						
22a	Interf Factor For In-beam Channels		1.0	1.0	1.0	1.0	1.0
22b	Interf Factor For Adj Beam Channels		0.5	0.5	0.5	0.5	0.5
22c	Interference Factor oth Ell sats		1.0	1.0	1.0	1.0	1.0
22d	IF-Oth Sys (incl X-pol & ant discr if any)		0.25	0.25	0.25	0.25	0.25
23	Uplink Signal to Interference Ratio (S/IF)	dB	-18.74	-18.50	-18.28	-18.08	-17.60
	INTERMODULATION						
24	Downlink Carrier to Intermodulation Ratio (C/IM)	dB	18	18	18	18	18
25	Downlink Signal to Intermodulation Ratio (S/IM)	dB	-2.97	-2.79	-2.75	-2.78	-3.01
	LINK PERFORMANCE						
26	Composite Signal to Noise Ratio (S/N+IF+IM)	dB	-20.45	-20.32	-20.40	-20.75	-21.63
27	Processing Gain	dB	27.17	27.17	27.17	27.17	27.17
28	Received Eb/No	dB	6.72	6.85	6.77	6.42	5.54
29	Required Eb/No	dB	3.00	3.00	3.00	3.00	3.00
30	**Margin**	**dB**	**3.7**	**3.8**	**3.8**	**3.4**	**2.5**
31	**Additional Margin for Power Control**	**dB**	**10**	**10**	**10**	**10**	**10**

Table 9
Ellipso C-Band PFDs

Item	C-band Service PFDs		Wideband		Narrowband Fixed		Narrowband Mobile	
			Altitude:		Altitude:		Altitude:	
			3500 km	7846 km	3500 km	7846 km	3500 km	7846 km
34	PFD/m^2/4 khz, nadir	dBw/4khz/m2	-155.93	-162.94	-154.00	-161.01	-155.93	-162.94
34a	Permitted PFD	dBw/4khz/m2	-144.00	-144.00	-144.00	-144.00	-144.00	-144.00
34b	Margin	dB	11.93	18.94	10.00	17.01	11.93	18.94
35	PFD/m^2/4 khz, 5°	dBw/4khz/m2	-166.57	-171.36	-158.33	-163.13	-166.57	-171.36
35a	Permitted PFD	dBw/4khz/m2	-154.00	-154.00	-154.00	-154.00	-154.00	-154.00
35b	Margin	dB	12.57	17.36	4.33	9.13	12.57	17.36
36	PFD/m^2/mhz, nadir	dBw/mhz/m2	-131.95	-138.96	-130.02	-137.03	-131.95	-138.96
36a	Permitted PFD	dBw/mhz/m2	-124.00	-124.00	-124.00	-124.00	-124.00	-124.00
36b	Margin	dB	7.95	14.96	6.02	13.03	7.95	14.96
37	PFD/m^2/mhz, 5°	dBw/mhz/m2	-142.59	-147.38	-134.35	-139.15	-142.59	-145.28
37a	Permitted PFD	dBw/mhz/m2	-134.00	-134.00	-134.00	-134.00	-134.00	-134.00
37b	Margin	dB	8.59	13.38	0.35	5.15	8.59	11.28
38	PFD/m^2/4 khz @ GEO (0dBi backlobe)	dBw/4khz/m2	-183.99		-182.06		-183.99	
38a	Permitted PFD	dBw/4khz/m2	-168.00		-168.00		-168.00	
38b	Margin	dB	15.99		14.06		15.99	
39	PFD/m^2/4 khz @ GEO (via earth limb)	dBw/4khz/m2	-182.12		-173.89		-182.12	
39a	Permitted PFD	dBw/4khz/m2	-168.00		-168.00		-168.00	
39b	Margin	dB	14.12		5.89		14.12	

Table 10
Ellipso Tracking, Telemetry, and Command Link Budgets

Item	Parameter	Unit	Amount
	GENERAL		
1	Data Rate, Uplink	bps	2400
2	Data Rate, Downlink	bps	4800
3	RF Bandwidth, Uplink	MHz	2500
4	RF Bandwidth, Downlink	MHz	5000
	UPLINK		
5	Frequency	MHz	15450.25
6	EIRP/carrier	dBW	53.24
6a	Transmit Power	W	1.00
6b	Line Loss	dB	2
6c	Transmit Antenna Gain (4.5 m)	dBi	55.2
7	Free Space Loss	dB	198.09
7a	Range (extreme)	km	12400
8	Atmospheric Losses	dB	2.00
9	Receive Antenna Gain (omni)	dBi	0.00
10	Received Power/carrier	dBW	-146.85
11	Thermal Noise Density	dBW/Hz	-200.82
11a	Receiver Temperature	°K	600
12	Thermal Noise Power	dBW	-166.84
13	Uplink Signal to Noise Ratio (S/N)	dB	19.99
14	Uplink Eb/No	dB	20.17
15	Required Eb/No	dB	6.30
16	Margin	dB	13.87
	DOWNLINK		
17	Frequency	MHz	6861
18	EIRP/carrier	dBW	-14.01
18a	Transmit Antenna Gain	dBi	0.00
18b	Transmission Line Loss	dB	1.00
18c	Transmit Signal Power	w	0.05
19	Free Space Loss	dB	191.04
19a	Range	km	12400
20	Atmospheric Losses	dB	1.00
21	Receive Antenna Gain (omni)	dBi	48.2
22	Received Signal Power	dBW	-157.86
23	Incident PFD per m^2 per 4 khz	dBw/4khz/m2	-160.85
24	Incident PFD per m^2 per mhz	dBw/mhz/m2	-136.87
25	PFD/m^2/4 khz @ GEO arc (backlobe)	dBw/4khz/m2	-191.90
26	PFD/m^2/4 khz @ GEO arc (via earth limb)	dBw/4khz/m2	-175.43
27	Thermal Noise spectral density	dBW/Hz	-206.84
28	Receiver Temperature	K	150
29	Thermal Noise Power	dBW	-169.85
30	Downlink Signal to Noise Ratio (S/N)	dB	11.99
31	Received Eb/No	dB	12.17
32	Required Eb/No	dB	6.30
33	Margin	dB	5.87

Table 11
Ellipso Tracking, Telemetry, and Command PFD Levels

Item	C-band TT&C PFDs		Altitude	
			3500 km	7846 km
34	PFD/m^2/4 khz, nadir	dBw/4khz/m2	-156.85	-163.86
34a	Permitted PFD	dBw/4khz/m2	-144.00	-144.00
34b	Margin	dB	**12.85**	**19.86**
35	PFD/m^2/4 khz, 5°	dBw/4khz/m2	-162.88	-167.68
35a	Permitted PFD	dBw/4khz/m2	-154.00	-154.00
35b	Margin	dB	**8.88**	**13.68**
36	PFD/m^2/mhz, nadir	dBw/mhz/m2	-132.87	-139.89
36a	Permitted PFD	dBw/mhz/m2	-124.00	-124.00
36b	Margin	dB	**8.87**	**15.89**
37	PFD/m^2/mhz, 5°	dBw/mhz/m2	-138.90	-143.70
37a	Permitted PFD	dBw/mhz/m2	-134.00	-134.00
37b	Margin	dB	**4.90**	**9.70**
38	PFD/m^2/4 khz @ GEO (0dBi backlobe)	dBw/4khz/m2	-194.91	
38a	Permitted PFD	dBw/4khz/m2	-168.00	
38b	Margin	dB	**26.91**	
39	PFD/m^2/4 khz @ GEO (via earth limb)	dBw/4khz/m2	-178.44	
39a	Permitted PFD	dBw/4khz/m2	-168.00	
39b	Margin	dB	**10.44**	

Table 12
Ellipso Satellite Weight Budget

	Concordia Mass, kg	Borealis Mass, kg
Payload	160	160
S/C Bus		
Propulsion, Attitude Control	52	52
TT&C	32	32
Prime Power: Array, Drive, Batteries, PC&DU	250	250
Support: Structure, Thermal, Harness, Balance	115	115
Total Bus	449	449
Total Dry Mass	609	609
Propellant	22	35
Launch Mass	631	644

Table 13
Ellipso Satellite Power Budget

	Maximum, W	Orbit Avg, W
Forward	1812	
Return	934	
Subtotal	2745	
Contingency	275	
Total Payload	3020	2023
Bus		219
Total S/c		2242

Table 14
Satellite RF Figures of Merit

Transponder Gains		
Forward (Ku to S Bands)	Adjustable, 122 - 137 dB	
Return (L to C Bands)	Adjustable, 122 - 137 dB	
Total Satellite Available RF Power:	500 watts	
RF Power per Beam	Variable with loading	
L- and S-Band Antenna Design	Circular 127 Element Active Array	
L-Band Array Diameter	75 inches	
S-Band Array Diameter	50 inches	
L- and S-Band Antenna Gains and G/Ts	Gain	G/T
Inner	28.8 dBi	2.0 dB/°K
First ring beam	28.7 dBi	1.9 dB/°K
Second ring beam	28.5 dBi	1.7 dB/°K
Third ring beam	28.1 dBi	1.4 dB/°K
Fourth ring beam	27.8 dBi	1.1 dB/°K
L- to S-Band Beam Pattern Mapping	Congruent mapping (identical coverages)	
L-Band Receiver Temperatures	475°K	
Feeder Link Antennas		
C-Band Antenna Design	Earth Coverage Horn Antenna	
C-Band RF Power	50 watts	
Ku Band Antenna Design	Earth Coverage Horn antenna	
Ku-Band Receiver Temperatures	600°K	
C and Ku Antenna Gains and G/Ts	Gain	G/T
C Band Earth Coverage	10.2 dBi	N/A
Ku Band Earth Coverage	10.0 dBi	-17.8 dB/°K