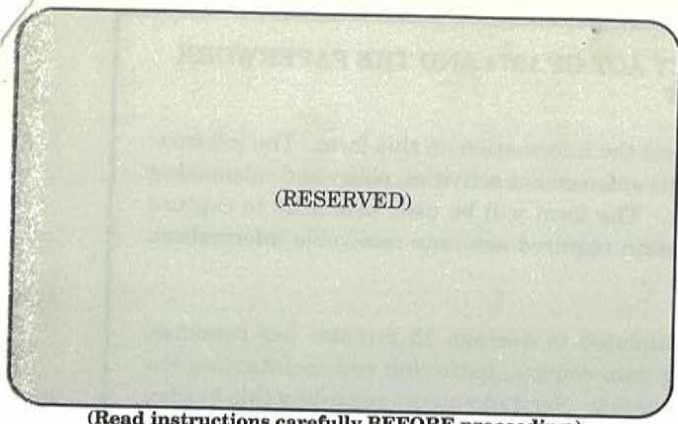


FCC REMITTANCE ADVICE

PAGE NO. 1 OF 1



(RESERVED)

(Read instructions carefully BEFORE proceeding.)

SPECIAL USE
FCC/MELLON JUL 02 1996

FCC USE ONLY
 Received

PAYOR INFORMATION

(1) FCC ACCOUNT NUMBER	Did you have a number prior to this? Enter it.	(2) TOTAL AMOUNT PAID (dollars and cents)
		\$ 5740.00
(3) PAYOR NAME (If paying by credit card, enter name exactly as it appears on your card)		

Satellite Policy Bureau
 International Bureau

(4) STREET ADDRESS LINE NO. 1
 EarthWatch, Incorporated
 6940 Koll Center Parkway

(5) STREET ADDRESS LINE NO. 2
 Suite 200

(6) CITY
 Pleasanton

(7) STATE
 CA

(8) ZIP CODE
 94566

(9) DAYTIME TELEPHONE NUMBER (Include area code)
 (510) 417-2040

(10) COUNTRY CODE (if not U.S.A.)

ITEM #1 INFORMATION

(11A) NAME OF APPLICANT, LICENSEE, REGULATEE, OR DEBTOR				FCC USE ONLY		
EarthWatch, Inc.						
(12A) FCC CALL SIGN/OTHER ID	(13A) ZIP CODE	(14A) PAYMENT TYPE CODE				(15A) QUANTITY
DA95-1707		B	F	Y	1	\$ 5740.00
(17A) FCC CODE 1			(18A) FCC CODE 2			
(19A) ADDRESS LINE NO. 1		(20A) ADDRESS LINE NO. 2		(21A) CITY/STATE OR COUNTRY CODE		

ITEM #2 INFORMATION

(11B) NAME OF APPLICANT, LICENSEE, REGULATEE, OR DEBTOR				FCC USE ONLY		
(12B) FCC CALL SIGN/OTHER ID	(13B) ZIP CODE	(14B) PAYMENT TYPE CODE				(15B) QUANTITY
						\$
(17B) FCC CODE 1			(18B) FCC CODE 2			
(19B) ADDRESS LINE NO. 1		(20B) ADDRESS LINE NO. 2		(21B) CITY/STATE OR COUNTRY CODE		

CREDIT CARD PAYMENT INFORMATION

(22) MASTERCARD/VISA ACCOUNT NUMBER:

Mastercard Visa

EXPIRATION DATE: /

(23) I hereby authorize the FCC to charge my account for the amount of \$ _____

AUTHORIZED SIGNATURE _____ DATE _____

ORIGINAL



28 June 1996

Via Overnight Delivery

Federal Communications Commission
c/o Mellon Bank
3 Mellon Bank Center
525 William Penn Way
27th Floor, Room 153-2713
Pittsburgh, Pennsylvania 15259-0001
(Attention: Wholesale Lockbox Shift Supervisor)

Please Direct to: Ms. Fern J. Jarmulnek
Chief, Satellite Policy Branch
Satellite & Radiocommunications Division

Re: Modification of Authorization: EarthWatch Incorporated: File No. DA 95-1707

Dear Ms. Jarmulnek:

EarthWatch Incorporated ("EarthWatch") hereby applies for authority to modify its authorization to construct, launch and operate its low-Earth orbit (LEO) remote-sensing satellite system; DA 95-1707 (*See also*, Files 21/22-DSS-P-93; 43 DSS-LA-94(2); 52-SAT-AMEND-95) to add two additional satellites to the system.

EarthWatch currently holds an FCC authorization to construct, launch and operate a remote sensing satellite system consisting of two satellites and associated ground stations.

Two additional satellites have been licensed by the National Oceanic and Atmospheric Administration ("NOAA") pursuant to the Land Remote Sensing Commercialization Act (15 U.S.C. § 4201 *et seq.*). Consequently, we are requesting the Commission to modify the EarthWatch FCC authorization to add two additional remote sensing satellites to the authorized EarthWatch system.

EarthWatch Incorporated: "An Imaging and Information Company"

6940 Koll Center Parkway #200 Pleasanton, CA 94566
Tel: 510.417.2040 Fax: 510.417.2045

The two new satellites will be very similar to the previously authorized satellites in terms of the communications systems and their operation, with a few improvements as follows:

- The inclination of the orbits will be 52 degrees and the altitude of the orbits will be 600 kilometers to improve the data gathering characteristics of the system;¹
- Component design life has been increased to five years;
- The resolution of the optical sensors will be improved to 1 meter IFOV panchromatic and 4 meters IFOV color;²
- The bandwidth of the space-to-earth data downlink³ will be increased to 350 MHz to handle the increased data flow resulting from the increased resolution of the optical sensors;⁴
- Downlink telemetry transmissions will be moved to the band 8025 - 8400 MHz and operate in a 4.2 MHz channel consistent with the data down-link frequencies and to avoid over crowding in the band presently utilized.
- Uplink telemetry transmission will be moved to the band 2025 - 2110 MHz and operate in a 30 KHz channel.
- Construction of the two satellites will commence in the fall 1996, expected completion in December 1997, anticipated launch in January 1998, and estimated date of placement into service in February 1998.

EarthWatch will coordinate with other agencies to ensure that the systems are compatible with other authorized users in the same or adjacent bands.

Pursuant to the Commission's rules, we enclose a completed fee processing form (FCC Form 159) and a check in the amount of five-thousand seven-hundred forty dollars (\$5740) made payable to the Federal Communications Commission to cover the cost of the requisite filing fee

¹ Precise orbit characteristics are controlled by the Department of Commerce and may not be changed without prior approval of the Department of Commerce.

² Spatial resolution is one of the technical characteristics which was carefully reviewed by the Department of Commerce and subjected to review by the Department of Defense and the State Department prior to approval.

³ A further technical description of the communications system is attached in Appendices 1-6.

⁴ The downlink will operate in the same band as the previously authorized satellites; 8025 - 8400 MHZ.

for modification of space station authorization. We include an extra copy of this modification marked "Return Copy" and kindly request that you date-stamp it and return it to EarthWatch in the enclosed envelope.

Please call the undersigned or EarthWatch's Washington, D.C. counsel, Mr. Dennis James Burnett, if you have any questions regarding this modification.

Very truly yours,

A handwritten signature in black ink, appearing to read "H. J. Gannes", with a long horizontal flourish extending to the right.

Howard J. Gannes
Vice President
EarthWatch Incorporated

cc: Dennis James Burnett, Esquire
Pierson & Burnett, L.L.P.
1667 K St., N.W., Suite 801
Washington, D.C. 20006
(202) 466-3044 (telephone)
(202) 466-3055 (facsimile)

encl: Original + 9 copies
Receipt copy

Appendix 1

EarthWatch IA Spacecraft Communications Overview

The EarthWatch IA communications architecture is shown in Figure 1. The EarthWatch IA spacecraft, an enhanced satellite system from EarthWatch, designed to improve ground image resolution will require an increase in downlink bandwidth. The system will communicate through Remote Ground Terminals (RGTs) in Italy, Japan, and the U.S. to and from the Mission Control Center (MCC) in Longmont, CO, USA. Links between the RGTs and the MCC will be established commercial satellite or terrestrial channels.

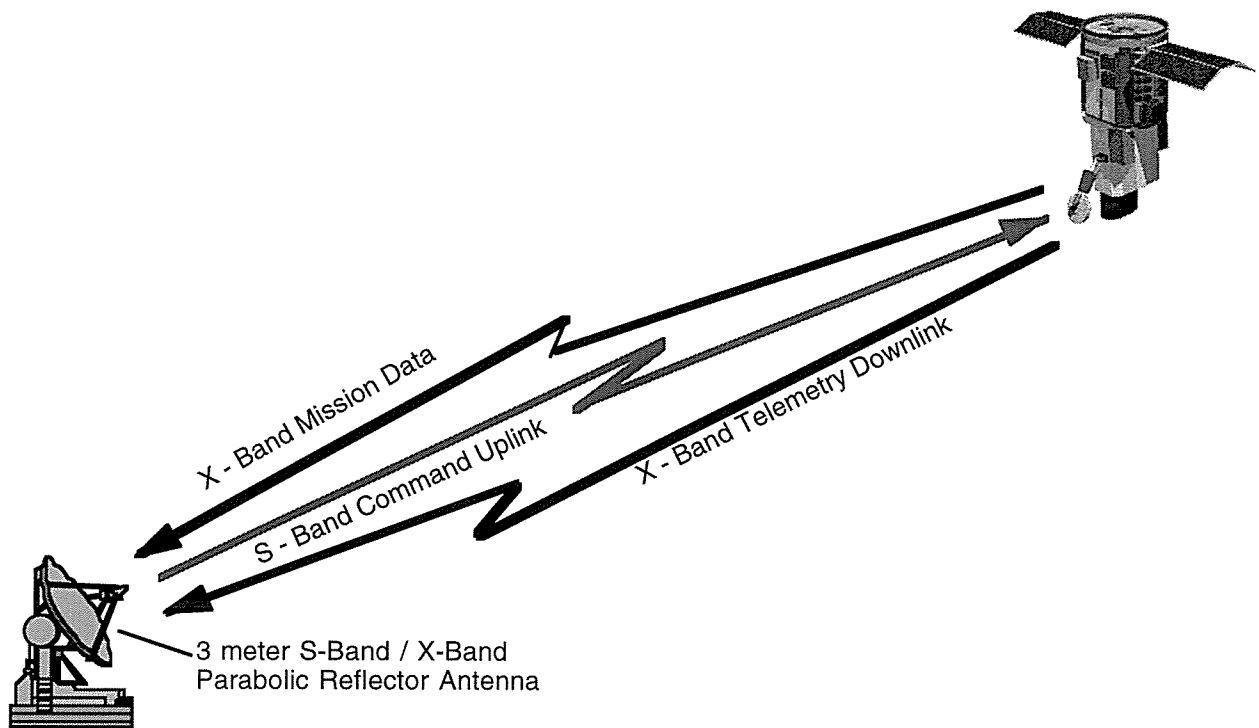


Figure 1 EarthWatch IA Communications Architecture

The EarthWatch IA space-ground communication links are described in Figure 2. The 320 Mbps wideband downlink will transmit compressed image data to the EarthWatch RGTs using the 8025 - 8400 MHz Earth Exploration Satellite X-band frequency allocation. The command uplink requires a 2 KHz channel in the 2025 - 2110 MHz STDN frequency allocation; the telemetry downlink resides in a 4.2 MHz channel at approximately 8030 MHz in the Earth Exploration Satellite allocation. All communications to and from the spacecraft will occur only while the vehicle is in view of a RGT. The additional command and telemetry frequencies requested for the EarthWatch IA spacecraft are required to support enhanced operations for an expanded constellation of spacecraft.

Link	Center Frequency	Modulation	Bandwidth / Data Rate	Encryption
Wideband Data	8185 MHz	QPSK	160 MHz / 320 Mbps	No (TBR)
Command Uplink	2025-2110 MHz (one channel)	FSK Tones	30 KHz / 2 Kbps	Yes
Telemetry Downlink	8030 MHz (two channel)	PCM/BPSK/PM	4.096/16.384 Kbps on 1.7 MHz sub carrier 256 Kbps on the carrier	Yes

Figure 2 EarthWatch IA Space-Ground Communication Links

Wideband Data Downlink

The Wide-Band Data Downlink, shown in Figure 3, will contain compressed image data. The 320 Mbps, QPSK downlink is centered at 8185 MHz. The wideband downlink flux density level is kept below the ground flux density levels specified in ITU Radio Regulation 2570 by emitting only enough energy (with adequate margin) as required by a 3 meter Remote Ground Terminal antenna. This design provides 4.1 dB of link margin and a minimum of 2 dB of margin with respect to ITU Radio Regulation 2570, detailed in Appendix 3. This link design also provides 4 dB of margin with respect to the $-176 \text{ dBW/m}^2 / 4 \text{ KHz}$ flux density levels at geosynchronous orbit given in ITU Radio Regulation 2631. During normal operation the flux density is -210 to $-220 \text{ dBW/m}^2 / 4 \text{ KHz}$ at geosync given the 30 to 40 dB front to back ratio of the transmit antenna. EarthWatch is mindful of the users in the band and has participated in the X-band workshops with NASA to assure system compatibilities.

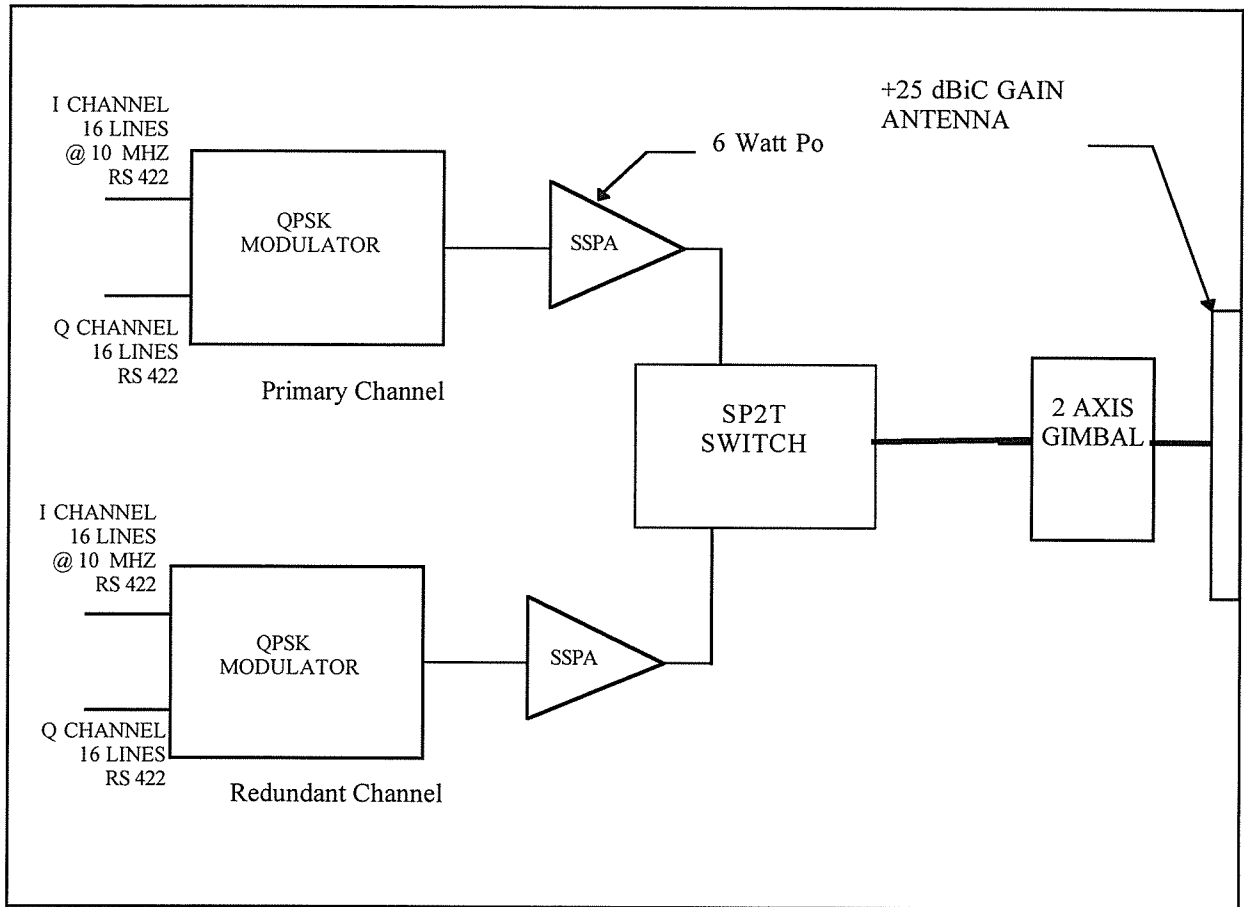


Figure 3 Wide-Band Data Downlink Functional Diagram

Particular care will be taken to ensure that out of band emissions in the 8400-8500 MHz NASA Deep Space Network band will be below the CCIR recommended limit. This is accomplished by a combination of bandpass filtering on the spacecraft and operational restrictions. In the band from 8400 - 8500 MHz the ground flux density level at the Deep Space Network site will be at least 4 dB below the recommended limit of $-255.1 \text{ dBW/m}^2 / \text{Hz}$. Appendix 2 gives the link calculations; Appendix 3 shows the flux density margins.

Command Uplink

The command uplink (ref. Figure 4) will convey commands that manage the operation of the spacecraft including the sensor subsystem. Adequate link margins and omni-directional antennas on the spacecraft will allow positive control during normal and anomalous operations. Commands to the spacecraft will be encrypted and authenticated to preclude unauthorized access and control. The commands will be encrypted at the EarthWatch Longmont, CO Mission Control Center before routing to any of the RGTs.

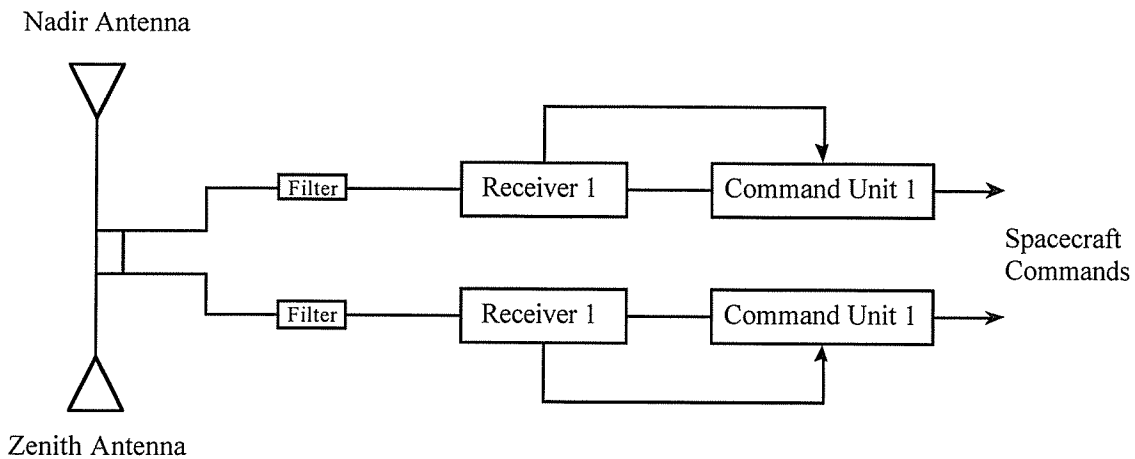


Figure 4 EarthWatch IA Command Uplink

All commands will be verified for correct word length, parity, and command decoder identification code. This will preclude the execution of corrupted commands. In addition critical commands will be protected using arming commands, so that a single inadvertent command cannot cause permanent damage to the satellite or its payload. The RGT radiated RF power will be adjustable so as to use the minimum power needed in order to guarantee a usable link. This will minimize the opportunities for co-channel interference with other users of the STDN uplink allocation. This design will conform to the limits on EIRP on Earth Station uplinks between 1-15 Ghz as specified in RR 2541. Appendix 4 gives the link calculations for the command uplink.

Telemetry Downlink

The telemetry downlink (ref. Figure 5) will contain spacecraft and sensor health and status data along with the information necessary for the processing and geolocation of the imagery. This link is encrypted to preclude unauthorized use of the image data on the wideband link.

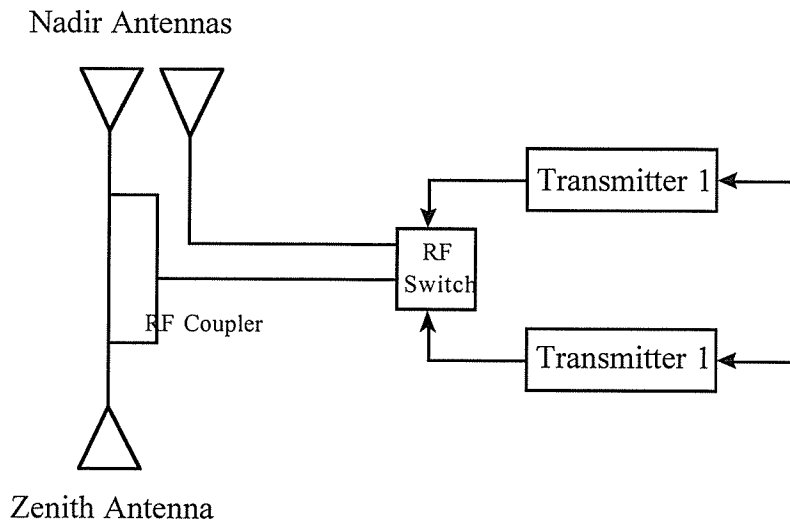


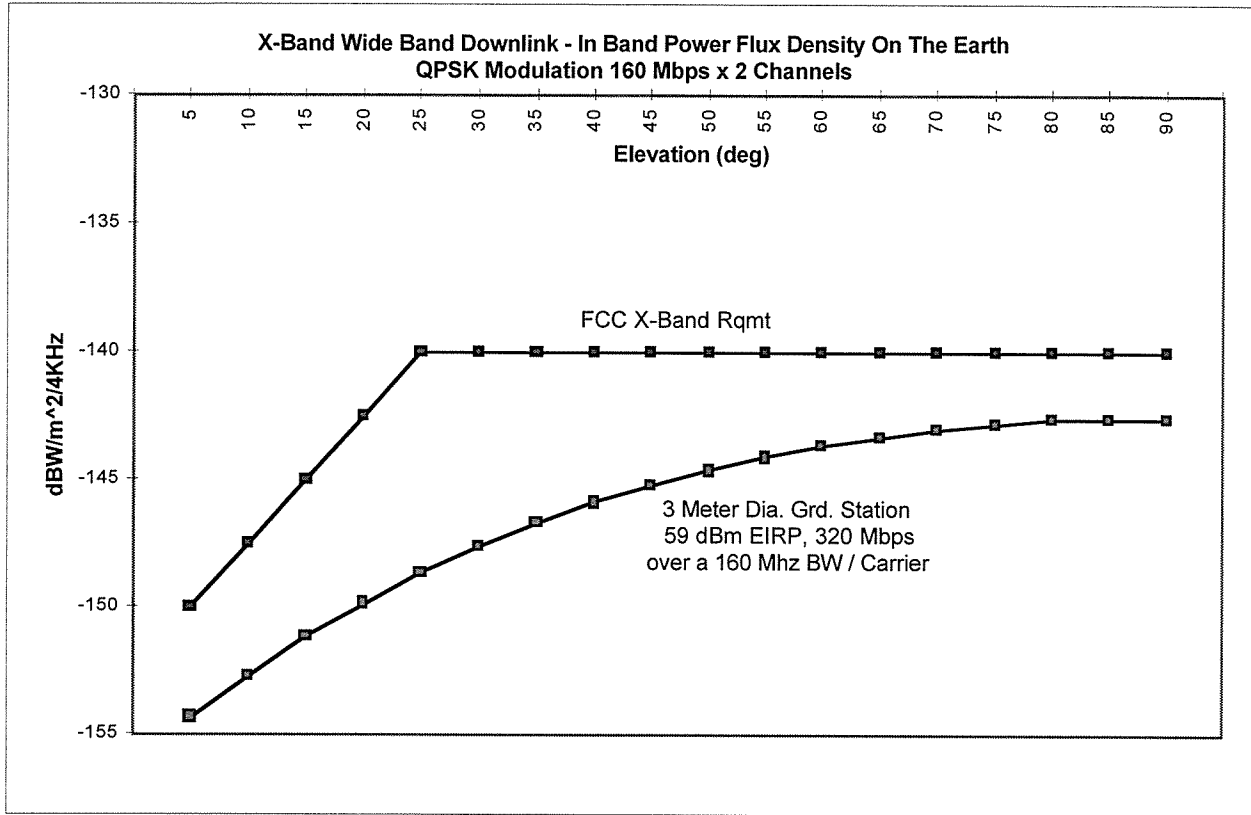
Figure 5 EarthWatch II Telemetry Downlink

The spacecraft can switch between omni-directional antennas with adequate link margins to assure contact can be maintained with the spacecraft under all conditions and a nadir-only antenna for increased gain during higher-rate normal operations. All commands to the spacecraft will be returned in the telemetry downlink for verification. The telemetry link calculations are shown in Appendix 5. The downlink flux levels will meet the requirements of ITU Radio Regulation 2557 by a minimum of 1.78 as shown in Appendix 6.

Appendix 2, Mission Data Downlink Analysis

320 MHZ DATA RATE DOWNLINK ANALYSIS	
Fo=8.185 GHz	
<u>DOWNLINK PARAMETERS:</u>	
Frequency:	8.185 GHz
Orbit Height in km	600 Km
Local elevation angle above hor.	5 degrees
Data Rate	320 Mbps
Bandwidth	171.2 Mbps
Spacecraft Ant EIRP @ max scan	58.9 dBm
Slant Range:	2327.8 km
Ground Antenna G/T:	23 dB/K
BER	1.00E-09
Required Eb/No (Without Coding)	12.55
Hardware Imp. BER Loss:	1.5 dB
<u>LINK CALCULATION:</u>	
<u>TOTAL POWER TO GROUND:</u>	
Satellite EIRP dBm	58.9 dBm
Path Loss:	-178.1 dB
Total Loss (Rain, Polarization, Ect.)	-3.0 dB
<u>RECEIVER SENSITIVITY:</u>	
Required Eb/No	10.1 dB (With Coding Gain & Hardware BER Losses)
Available Eb/No	14.1 dBm
<u>DOWNLINK MARGIN:</u>	
4.1 dB	
<u>ANTENNA SIZES:</u>	
<u>Spacecraft Antenna Segment</u>	
Spacecraft Dish Diameter	11 inches
Approx. HPBW	9.01 degrees
Gain of Spacecraft Antenna	25.0 dBi
Loss Between HPA out & Ant. input	1.5 dB
Transmitter Po	3.5 Watts (@ xmitter output)
EIRP of satellite Ant. System	58.9 dBm
<u>Ground Antenna Segment</u>	
Ground Antenna G/T:	23 dB/K
System Noise Temperature:	187.2 K (Referenced at Aperture)
Directivity Gain Ground Antenna	45.7 dBiC
Ground Dish Diameter:	3.0 meters
Approx. HPBW	0.8 degrees

Appendix 3, Power Flux Density; Wideband Downlink



Appendix 5, Narrowband Downlink Link Analysis

TELEMETRY DOWNLINK		R/T,PBK /NADIR	
Earth Watch			
FREQUENCY	8.2 GHz	WAVELENGTH	0.036585 METERS
POWER	5 WATTS	ALTITUDE	600 KM
ALTITUDE	600 KM	5 DEG SLANT RANGE =	2329.013 KM
REAL TIME DATA ON 1.7, PCM/PSK/PM		DATA RATE	16.384 KBPS
PLAY BACK DATA PCM/PM		DATA RATE	256 KBPS
		MARGIN	dB
R/T MOD INDEX	0.5	CARRIER	31.1
PBK MOD INDEX	1	R/T	5.3
		PBK	6.0
ANTENNA: NADIR			
PARAMETER	UNITS	VALUE	
1 TOTAL TRANSMIT POWER	dBm	37.0	
2 PASSIVE LOSS	dB	-2.5	
3 S/C ANTENNA GAIN >+/- 90DEG	dB	-9.0	
4 FREE SPACE DISPERSION LOSS	dB	-178.1	
5 ATMOSPHERIC LOSS	dB	-1.0	
6 GROUND STATION G/T (spec)	dB/K	24.8	
7 TOTAL RECEIVED POWER/T	dBm/K	-128.8	
8 BOLTZMAN CONSTANT	dBm/Hz/K	-198.6	
9 TOTAL RECEIVED POWER/KT		69.8	
CARRIER CHANNEL			
10 CARRIER/TOTAL POWER	dB	-5.9	
11 CARRIER POWER/KT (min)	dBm/Hz/KT	63.9	
12 CARRIER LOOP BW (60 Hz)	dB-Hz	17.8	
13 CARRIER/NOISE	dB	46.1	
14 REQUIRED CARRIER/NOISE	dB	15.0	
15 CARRIER MARGIN	dB	31.1	
DATA CHANNEL (PCM/PM) (playback)			
16 DATA/TOTAL POWER (MI=1.0)	dB	-2.1	
17 DATA POWER/KT	dBm/Hz/KT	67.8	
18 INFORMATION RATE 256 KBPS	dB-Hz	54.1	
19 AVAILABLE S/N	dB	13.7	
20 REQUIRED Eb/No 10E-5 BER	dB	12.1	
21 CODING GAIN	dB	4.4	
22 AVAILABLE SIGNAL MARGIN	dB	6.0	
DATA CHANNEL (PCM/PSK/PM) (real time)			
23 DATA/TOTAL POWER (MI=.5)	dB	-14.7	
24 DATA POWER/KT	dBm/Hz/KT	55.2	
25 INFORMATION RATE (16 KBPS)	dB-Hz	42.1	
26 AVAILABLE S/N	dB	13.0	
27 REQUIRED Eb/No 10E-5 BER	dB	12.1	
28 CODING GAIN	dB	4.4	
29 AVAILABLE SIGNAL MARGIN	dB	5.3	

Appendix 6, Flux Density; Narrowband Downlink

