to issue an STA to ARC.

II. Request for Temporary Authority

ARC is applying for special temporary authority to operate TDRS-5, a C-band satellite, on a non-common carrier basis to provide domestic fixed satellite service from 62° W.L.

ARC's address is:

ARC Professional Services Group, Inc.
585 Grove Street
Suite 300
Herndon, Virginia 22070

Inquiries and correspondence should be addressed to Mr. L. Roy Patterson at the above address, with a copy to Counsel for ARC:

James G. Ennis, Esquire
Fletcher, Heald & Hildreth
1225 Connecticut Ave, N.W., Suite 400
Washington, D.C. 20036
Telephone: (202) 828-5700

ARC will operate the C-band transponders on TDRS-5 as a private, non-common carrier. ARC's only customer will be NASA; ARC will not make the C-band transponder capacity available to the public generally. Thus, ARC will not be providing common

carrier services.

ARC will retain exclusive responsibility for the operation and control of the radio facilities with respect to the C-band transponders. ARC will have full operational control over the C-band transponders, including maintenance of transponder performance and authority to turn off any C-band transponder if necessary.

Space Communications Company (Spacecom), the company which owns the TDRS system and provides NASA with the S- and Ku- band TDRS services, will be responsible for adjusting the attitude and orbital position of the TDRS-5 satellite. However, ARC will monitor and test the C-band transponders through its own uplink, and will command and control the C-band transponders through an information link connecting the ARC operating center with Spacecom's T,T&C station in White Sands, New Mexico. ARC will be able to activate and deactivate the C-band transponders through the information link.

III. ARC is Legally Qualified to Receive an STA to Operate the C-Band Transponders on the TDRS Satellite at 62° W.L.

ARC is a domestic corporation organized under the laws of the State of Maryland. ARC is a wholly-owned subsidiary of

Atlantic Research Corporation, which is in turn a wholly-owned subsidiary of Sequa Corporation. Both Atlantic Research Corporation and Sequa Corporation are corporations organized under the laws of the State of Delaware. A copy of a current Form 430, "Common Carrier and Satellite Radio Licensee Qualification Report" for ARC is appended hereto as Appendix 1.

ARC's immediate predecessor-in-interest was a company named ORI, Inc. ("ORI"). ORI, like ARC, was a company wholly controlled by Atlantic Research Corporation. In turn, ORI's predecessor-in-interest was a company named Systematics General Corporation ("SGC"). It, too, was a wholly-owned subsidiary of Atlantic Research Corporation.

On numerous occasions in the past, the Commission has issued ORI and SGC special temporary authorizations ("STAs")1/ to provide domestic service to government agencies using the C-

---

1/ Section 154(i) provides the Commission with the legal basis for issuing an STA. Under Section 154(i) of the Communications Act, 47 U.S.C. §154(i), the Commission is empowered to "perform any and all acts . . . and issue such orders, not inconsistent with this chapter, as may be necessary in the execution of its functions." This extends to issuing STAs. See, e.g., KDAB, Inc., 91 F.C.C.2d 277, 52 R.R.2d 201, 207 (1982); Gale Broadcasting Co., Inc., 19 F.C.C.2d 623, 626 (1969). Since the 180 day limitation does not apply in the case of STAs authorized pursuant to Section 154(i), the requested STA can be issued until further order of the Commission, and hence does not need to be renewed every six months. See Systematics General Corporation, 2 FCC Rcd 7550, 7551 (1987).

band capacity on the TDRS satellites. Thus, in 1985, the Commission authorized SGC to apply for an STA to provide domestic service using the C-band transponders on TDRS-1 at 41° W.L.2/ Pursuant to this decision, SGC applied for, and received, an STA to test and verify the C-band transponders on TDRS-1 at 41° W.L.3/

Similarly, in 1987, in anticipation of the move of TDRS-1 from 41° W.L. to 62° W.L. and its replacement at 41° W.L. by TDRS-3 (now designated TDRS-4), the Commission issued ORI an STA to provide domestic service using TDRS-1 from 41° W.L. and from 62° W.L.4/ It also issued ORI an STA to provide domestic service using TDRS-3 (now TDRS-4) at 41° W.L.5/ Lastly, in August, 1987, the Common Carrier Bureau authorized SGC to apply for an STA to operate TDRS-3 (now TDRS-4) at 41° W.L. to provide

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2/ Systematics General Corporation, 103 F.C.C.2d 879 (1985).

3/ Letter of James R. Keegan, Ref. No. 61330 (Nov. 19, 1985).

4/ Since receiving this STA authority, TDRS-1 has been relocated to 79° W.L., not 62° W.L., and plans to use its C-band capacity have been shelved in order to conserve fuel on the spacecraft in case it is needed for TDRS purposes.

5/ Systematics General Corporation, 2 FCC Rcd 7550 (1987). The Commission recently approved the transfer of the STA authorization for TDRS-4 at 41° W.L. from ORI to ARC. Letter of James R. Keegan, Ref. No. 61330 (October 23, 1989). NASA has recently decided to sell Intelsat the use of the C-band capacity on the TDRS-4 satellite at 41° W.L. to meet Intelsat's needs.

international service.6/

The reason the Commission has chosen to issue STAs to ARC's predecessors-in-interest rather than licenses is that the TDRS satellites contain only twelve C-band transponders each and therefore do not meet the frequency re-use requirements the Commission has established for domestic fixed satellite service satellites.7/ In issuing an STA instead of a regular license to cover the operation of the TDRS satellites, the Commission has indicated that the C-band transponders on the TDRS satellites may be used until another operator is prepared to occupy the orbital positions where the TDRS satellites are located with more efficient C-band satellites.8/

ARC's request for an STA to operate TDRS-5 at 62° W.L. follows the procedure previously established by the Commission for utilizing the capacity on the TDRS satellites and does not raise any new or novel issues.

6/ The Commission adopted a full frequency re-use requirement in its August, 1983 Reduced Orbital Spacing decision. See, In the Matter of Licensing of Space Stations in the Domestic Fixed Satellite Service and Related Revisions of Part 25 of the Rules and Regulations, in ___ F.C.C.2d ___, 54 R.R.2d 577 (1983).

7/ Systematics General Corporation, 2 FCC Rcd 5406 (1987).

8/ Systematics General Corporation, 103 F.C.C.2d 879, 882 (1985).

In connection with the operation of TDRS-5 at 62° W.L., a copy of the IFRB information called for by Section 25.202(c) of the Commission's Rules is appended hereto as Appendix 2. This information is also being submitted under separate cover to the Commission.

IV. ARC is Financially Qualified to Receive an STA to Operate the C-Band Transponders on the TDRS Satellite at 62° W.L.

ARC is financially qualified to provide the requested service, as is evidenced by the material attached hereto as Appendix 3.

V. ARC is Technically Qualified to Receive an STA to Operate the C-Band Transponders on the TDRS Satellite at 62° W.L.

ARC is technically qualified to provide the requested service, as is evidenced by the material attached hereto as Appendix 4.

VI. Grant of ARC's Request For an STA Would Serve the Public Interest, Convenience, and Necessity

Grant of ARC's application will serve the public interest, convenience, and necessity in several ways. First, issuance of

special temporary authority will allow efficient use of the C-band spectrum which is available and currently unused at 62° W.L. If the C-band transponders on TDRS-5 are not used, the available C-band spectrum at 62° W.L. will lie fallow for at least the near future. Allowing TDRS-5's C-band transponders to remain unused -- when beneficial use can be made of them without prejudice to anyone -- would run counter to the Commission's goal of efficient use of U.S. orbital and spectrum resources.

Second, issuance of special temporary authority will permit the capacity of an in-orbit satellite to be fully utilized. Regardless of whether or not the C-band transponders can be used, the TDRS-5 satellite will be launched to serve as an in-orbit spare for the tracking and data relay satellite network which operates on government frequencies in the Ku- and S-bands. However, as the Commission is well aware, the government has expended substantial public funds to build the C-band portion of the TDRS-5 space station. U.S. taxpayers have paid approximately $35 million for the construction of the commercial capacity on TDRS-5.9/ If these transponders cannot be used, that expenditure will have been wasted.

9/ The commercial portions of the six TDRS satellites (not all of which have been fully constructed) cost approximately $210.1 million, according to figures published in the FCC's decision in Western Union Telegraph Company, 86 F.C.C.2d 196, 203, ___ R.R.2d ___, ____ (1981). This corresponds to $35 million per satellite.

Third, grant of ARC's request for an STA will permit ARC to provide NASA with a needed communications service. NASA intends to use the C-band transponders to meet its point-to-point data communications requirements.10/ NASA's requirements include a need for a domestic satellite communications system with secure command/control links such as the TDRS-5 satellite offers.

VII. Waiver Pursuant to Section 304 of the Communications Act of 1934

Pursuant to Section 304 of the Communications Act of 1934, ARC Professional Services Group, Inc. waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests the grant of temporary operating authority in accordance with this application.

VIII. Conclusion

Special circumstances warrant temporary authorization so long as the Communications Act and the Commission's policies

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10/ NASA has requested ARC to provide regular TDRS C-band service as early as possible after TDRS-5 is operational. Prior to and in preparation for providing such service, ARC must test and validate control procedures and command protocols and determine service characteristics.

are not adversely affected.11/ In granting temporary authorization, the Commission is primarily concerned with efficient resource utilization.12/ ARC submits that its request for special temporary authority is clearly warranted under Section 154(i) of the Communications Act because of the circumstances described above and the need to use public resources efficiently. Therefore, it requests temporary authority to operate the twelve C-band transponders on TDRS-5 at 62° W.L., beginning in January, 1991, in order to provide domestic fixed satellite service to NASA.

my/jge02(1)sgc1

11/ GTE Satellite Corporation, 90 F.C.C.2d 1009 (1983).

12/ Memorandum of Opinion, Order and Authorization, In the Matter of the Application of Satellite Business Systems for Temporary Use of the 101° W.L. Orbital Position by the SBS-4 Domestic Fixed Satellite, Mimeo No. 5207, File No. 170-DSS-MP/ML-84, released July 9, 1984, at para.4.

ARC Professional Services
Group, Inc.
Application for STA for
TDRS-5
January, 1990

APPENDIX 1

FCC Form 430
Common Carrier and Satellite Radio
Licensee Qualification Report

FCC 430

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

Approved By OMB
3060-0105
Expires 3/31/87

COMMON CARRIER AND SATELLITE RADIO LICENSEE QUALIFICATION REPORT

INSTRUCTIONS

A. The "Filer" of this report is defined to include: (1) An applicant, where this report is submitted in connection with applications for common carrier and satellite radio authority as required for such applications; or (2) A licensee or permittee, where this report is required by the Commission's Rules to be submitted on an annual basis.

B. Submit an original and one copy (sign original only) to the Federal Communications Commisison, Washington, D.C. 20554. If more than one radio service is listed in item 6, submit an additional copy for each such additional service. If this report is being submitted in connection with an application for radio authority, attach it to that application.

C. Do not submit a fee with this report.

1. Business Name and Address (Number, Street, City, State and ZIP Code) of Filer's Principal Office:
ARC Professional Services Group, Inc.
585 Grove Street, Suite 300
Herndon, Virginia 22070

2. (Area Code) Telephone Number
(703) 834-5600

3. If this report supercedes a previously filed report, specify its date:
8/21/89

4. Filer is (check one):
☐ Individual ☐ Partnership ☒ Corporation
☐ Other *(Specify):*

5. Under the laws of what State (or other jurisdiction) is the Filer organized?
Maryland

6. List the common carrier and satellite radio services in which Filer has applied or is a current licensee or permittee:
Domestic and International Satellite Services

7(a) Has the Filer or any party to this application had any FCC station license or permit revoked or had any application for permit, license or renewal denied by this Commission? ☒ Yes ☐ No
If **"YES,"** attach as Exhibit I, a statement giving call sign and file number of license or permit revoked and relating circumstances.

(b) Has any court finally adjudged the Filer, or any person directly or indirectly controlling the Filer, guilty of unlawfully monopolizing or attempting unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement, or other means of unfair methods of competition? ☐ Yes ☒ No
If **"YES,"** attach as Exhibit II a statement relating the facts.

(c) Has the Filer, or any party to this application, or any person directly or indirectly controlling the Filer ever been convicted of a felony by any state or Federal Court? ☐ Yes ☒ No
If **"YES,"** attach as Exhibit III a statement relating the facts.

(d) Is the Filer, or any person directly or indirectly controlling the Filer, presently a party in any matter referred to in items 7(b) and 7(c)? ☐ Yes ☒ No
If **"YES,"** attach as Exhibit IV a statement relating the facts.

8. Is the Filer, directly or indirectly, through stock ownership, contract or otherwise, currently interested in the ownership or control of any other radio stations licensed by this Commission? ☐ Yes ☒ No
If **"YES"** submit as Exhibit V, the name of each such licensee and the licensee's relation to the Filer.

If Filer is an individual (sole proprietorship) or partnership, answer the following and Item 11:

9(a) Full Legal Name and Residential Address (Number, Street, City, State and ZIP Code) of Individual or Partners:

(b) Is individual or each member of a partnership a citizen of the United States? ☐ Yes ☐ No

(c) Is individual or any member of a partnership a representative of an alien or of a foreign government? ☐ Yes ☐ No

If Filer is a corporation, answer the following and Item 11:

10(a) Attach as Exhibit VI, the names, addresses, and citizenship of those stockholders owning of record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries.

Attached as Exhibit VI

(b) List below, or attach in Exhibit VII, the names and addresses of the officers and directors of the Filer.

Attached as Exhibit VII

(c) Is the Filer directly or indirectly controlled by any other corporation? ☒ Yes ☐ No
If **"YES,"** attach as Exhibit VIII a statement (including organizational diagrams where appropriate) which fully and completely identifies the nature and extent of control. Include the following: (1) the address and primary business of the controlling corporation and any intermediate subsidiaries; (2) the names, addresses, and citizenship of those stockholders holding 10 percent or more of the controlling corporation's voting stock; (3) the approximate percentage of total voting stock held by each such stockholder; and (4) the names and addresses of the president and directors of the controlling corporation.

(d) Is any officer or director of the Filer an alien? ☐ Yes ☒ No

(e) Is more than one-fifth of the capital stock of the Filer owned of record or voted by aliens or their representatives, or by a foreign government or representatives thereof, or by a corporation organized under the laws of a foreign country? ☐ Yes ☒ No

(f) Is the Filer directly or indirectly controlled: (1) by any other corporation of which any officer or more than one-fourth of the directors are aliens, or (2) by any foreign corporation or corporation of which more than one-fourth of the capital stock is owned or voted by aliens or their representatives, or by a foreign government or representatives thereof. ☐ Yes ☒ No

(g) If any answer to questions (d), (e) or (f) is **"YES,"** attach as Exhibit IX a statement identifying the aliens or foreign entities, their nationality, their relationship to the Filer, and the percentage of stock they own or vote.

11. CERTIFICATION

This report constitutes a material part of any application which cross-references it, and all statements made in the attached exhibits are a material part hereof. The ownership information contained in this report does not constitute an application for, or Commission approval of, any transfer of control or assignment of radio facilities. The undersigned, individually and for the Filer, hereby certifies that the statements made herein are true, complete and correct to the best of Filer's knowledge and belief, and are made in good faith.

WILLFUL FALSE STATEMENTS MADE ON THIS APPLICATION ARE PUNISHABLE BY FINE AND IMPRISONMENT [U.S. Code, Title 18, Section 1001] AND/ OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION PERMIT [U.S. Code, Title 47, Section 312(a)(1)]

Date	Filer *(Must correspond with that shown in Item 1).*	Typed or Printed Name
1/9/90	ARC Professional Services Group, Inc.	L. Roy Patterson
Signature		Title Vice President
Lee Roy Patterson		

NOTICE TO INDIVIDUALS REQUIRED BY PRIVACY ACT OF 1974 AND THE PAPERWORK REDUCTION ACT OF 1980

The solicitation of personal information requested in this form is to determine if you are qualified to become or remain a licensee in a common carrier or satellite radio service pursuant to the Communications Act of 1934, as amended. No authorization can be granted unless all information requested is provided. Response is required to obtain the requested authorization or retain an authorization.

ARC Professional Services
Group, Inc.
FCC Form 430
Exhibit 1
January, 1990

Statement of
Circumstances Surrounding
Denial of Application

In August, 1985, the Commission dismissed applications filed by ARC Professional Services Group, Inc.'s predecessor in interest, Systematics General Corporation ("SGC"), for a permit to construct, launch, and operate SGC's applications because they did not meet the frequency re-use requirements it had adopted in 1983. However, the Commission stated it would permit SGC to operate the TDRS facilities pursuant to an STA. Systematics General Corp., 103 F.C.C.2d 879 (1985).

my/jge03exhibit

10(a)

ARC Professional Services Group, Inc. is a wholly-owned subsidiary of Atlantic Research Corporation which is a wholly-owned subsidiary of Sequa Corporation. Atlantic Research Corporation is a Corporation organized under the laws of the State of Delaware. Sequa Corporation is a Corporation organized under the laws of the State of Delaware.

Sequa Corporation has a Class A common stock, a Class B common stock, and a Preferred stock.

The Class A shares have one vote per share.
The Class B shares have ten votes per share.
The Preferred shares have one vote per share.

Mr. Norman E. Alexander, Chairman of the Board and Chief Executive Officer of Sequa Corporation, owns approximately 28% of the Class A common stock and 47% of the Class B common stock and, accordingly, has approximately 43% of the total voting stock of Sequa Corporation. He resides at 24 Morris Lane, Scarsdale, New York and is a United States citizen.

Paine Webber Incorporated holds more than 10% of the Sequa preferred shares but would only have less than 1% of the voting shares of Sequa Corporation.

Paine Webber's address is 1285 Avenue of the Americas, New York, New York 10020. Paine Webber is a corporation organized under the laws of the state of Delaware.

10(b)

The names and addresses of the members of ARC Professional Services Group, Inc. Board of Directors and Officers are as follows:

W. Gerald Hamm, President,
and Chairman of the Board
508 Council Court, NE
Vienna, VA 22180

William H. Borten, Director
10804 Balantre Lane
Potomac, MD 20854

Christopher W. Robertson, Director
6324 Youngs Branch Drive
Fairfax Station, VA 22039

Jon Cowell, Senior Vice President
and General Manager
13404 Haddonfield Lane
Darnestown, MD 20878

Edward T. Jones, Senior Vice President
and General Manager
3231-D Sutton Place, NW
Washington, DC 20016

Thomas H. Bell, Vice President
6716 Sage Court
Adamstown, MD 21710

Walter Bennett, Vice President
1628 Turnbull Road
Dayton, OH 45432

Edward D. Bjorn, Vice President
8647 Overlook Road
McLean, VA 22102

Barbara F. Biendl, Secretary
7810 Newington Woods Drive
Springfield, VA 22153

John E. Dodge, Vice President
3915 Rose Lane
Annandale, VA

James F. Farrell, Vice President
1427 Highland Drive
Silver Spring, MD 20910

Robert R. Featheringham, Vice President
11317 Freas Drive
Gaithersburg, MD 20875

Norbert Fraylick, Vice President
10408 Mercado Way
Gaithersburg, MD 20875

Cornelius Hensel, Senior Vice President
50 S. Van Dorn Street # D-314
Alexandria, VA 22304

Robert V. Lieg, Vice President, Treasurer
and Assistant Secretary
19100 Rhodes Way
Gaithersburg, MD 20879

Gill F. Livingston, Vice President
4046 Vacation Lane
Arlington, VA 22207

Larry D. Miller, Vice President
867 Clopper Road # T-4
Gaithersburg, MD 20878

L. Roy Patterson, Vice President
7 Sherwood Road
Annapolis, MD 21401

Ronald M. Proudfoot, Vice President
8012 Goodhurst Drive
Gaithersburg, MD 20879

Mitchell B. Rambler, Vice President
11005 Colonial Green Court
Gaithersburg, MD 20878

David L. Reed, Vice President
14649 Stonewall Drive
Silver Spring, MD 20904

P. Jennings Scearce, Vice President
909 Twin Oaks Drive
Rockville, MD 20852

John B. Stevens, Vice President
6315 Karmich Street
Fairfax Station, VA 22152

Anthony L. Ward, Vice President
7877 Heatherton Lane
Potomac, MD 20854

Earl W. Wells, Vice President
9024 Copenhaver Drive
Potomac, MD 20854

10(c) (1)

ARC Professional Services Group, Inc. is a wholly-owned subsidiary of Atlantic Research Corporation, which is a wholly-owned subsidiary of Sequa Corporation.

The corporate offices of Sequa Corporation are:

200 Park Avenue
New York, New York 10185

The primary business of Sequa Corporation is:

Sequa Corporation (formerly Sun Chemical Corporation), is a diversified company with principal interests in the fields of aerospace, military electronics and electro optics, specialty chemicals, machinery for container and printing markets and transportation.

The corporate offices of Atlantic Research Corporation are:

5390 Cherokee Avenue
Alexandria, Virginia 22312

The primary business of Atlantic Research Corporation is:

Atlantic Research Corporation is a high technology company that provides propulsion systems and products, professional and technical services, electronics and communications systems, TEMPEST services, and data comunications test equipment and systems.

- Continued on next page -

10(c) (2) and
10(c) (3)

The names, address, and citizenship of those stockholders holding 10 percent or more of Sequa Corporation's voting stock, and the approximate percentage of total stock held by each such stockholder are:

Norman E. Alexander
Chairman of the Board and Chief Executive Officer of Sequa Corporation
24 Morris Lane
Scarsdale, NY 10583
U. S. Citizen
Owns 43% of Sequa Corporation's voting stock

10(c) (4)

The names and addresses of the president and directors of the controlling corporation are:

Name	Business Address	Home Address
Robert E. Davis President and Director	Sequa Corporation 200 Park Avenue New York, NY 10166	Ten Old Jackson Ave. Hastings on Hudson, NY 10708
Stuart Z. Krinsly Senior Executive Vice President & Director	Sequa Corporation 200 Park Avenue New York, MY 10166	1135 Greacen Point Road Mamaroneck, NY 10543
Alvin Dworman	ADCO Group 645 Fifth Avenue New York, NY 10022	155 East 76th Street New York, NY 10021
A. Leon Fergenson	Penn Central Corporation 245 Park Avenue New York, NY 10017	Seven Meadow Place Larchmont, NY 10538
Raymond Frankel	Technological Investors Management Corporation 630 Third Avenue New York NY 10017	211 Hammocks Road Larchmont, NY 10538
David S. Gottesman	First Manhattan Company 437 Madison Avenue New York, NY 10017	26 Island Drive Rye, NY 20589

- continued on next page -

10(c) (4)

Name	Business Address	Home Address
Donald Kummerfeld	Magazine Publishers Association 575 Lexington Avenue New York, NY 10022	40 Central Park South New York, NY 10019
Richard S. LeFrak	LeFrak Organization, Inc. 97-77 Queens Boulevard Forest Hills, NY 11374	857 Fifth Avenue New York, NY 10021
Fred R. Sullivan	Kidde, Inc. Park 80 West - Plaza Two Saddle Brook, NJ 07862	857 Fifth Avenue New York, NY 10021
Gerald Tsai, Jr.	Primerica Corporation 200 Park Avenue New York, NY 10166	910 Fifth Avenue New York, NY 10021

ARC Professional Services
Group, Inc.
Application for STA for
TDRS-5
January, 1990

APPENDIX 2

IFRB Advance Publication
and
Coordination Information for
TDRS-5 at 62° W.L.

INFORMATION SUPPLIED FOR ADVANCE PUBLICATION FOR THE USASAT SATELLITE NETWORK

General Information

The Administration of the United States of America informs the Members of the I.T.U. of its intention to authorize the operation of the planned USASAT Satellite Network which is proposed to provide domestic telecommunications services.

Section B. General Characteristics to be Furnished for a Satellite Network

Item 1 Identity of the Satellite Network

USASAT

Item 2 Date of Bringing into Use

31 December 1992

Period of Validity

15 years

Item 3 Administration Submitting the Advance Information

United States of America

Federal Communications Commission FEDCOMCOM
Washington, D.C. 20554 Washington, D.C.

Item 4 Orbital Information Relating to the Space Station

Nominal Geographic Longitude:	62 degrees West
Longitudinal Tolerance:	0.1 degrees
Inclination Excursion:	0.1 degrees
Visible Arc:	60 to 135 deg. West
Service Arc:	60 to 70 deg. West

Difference: Shaped-beam pattern limits useful service arc.

Section C. Characteristics of the Satellite Network in the Earth-to-Space Direction

Item 1 Earth-to-Space Service Areas

The 48 contiguous states of the United States, Puerto Rico and the U.S. Virgin Islands.

Item 2 Class of Stations and Nature of Service

TC

Item 3 Frequency Range

5925 - 6425 MHz

Item 4 Power Characteristics of the Transmitted Wave IntoThe Transmit Antenna

a)

Antenna diameter m	Maximum spectral power density dB(W/Hz)	On-axis gain dB(i)	Total peak envelope power dB(W)	Notes
10	-36.0	54.0	27.0	(1)
10	-46.0	54.0	27.0	(2)
10	-48.6	54.0	-1.1	(3)
5	-38.2	48.0	15.9	(4)

Notes:

(1) The necessary bandwidth of this emission is 36 MHz when modulated by the normal baseband signal and 2 MHz when modulated by a triangular energy dispersal waveform.

(2) The necessary bandwidth of this emission is 30 MHz.

(3) The necessary bandwidth of this emission is 100 kHz.

(4) The necessary bandwidth of this emission is 500 kHz.

b) Radiation pattern: CCIR Rec. 465-1.

c) Peak envelope power delivered to the antenna for television carriers: 27.0 dB(W).

d) Minimum carrier power delivered to the antenna for narrow-band carriers: -1.1 dB(W).

Item 5 Characteristics of the Space Station Receiving Antenna

a) Gain contours: See Figure 1.

c) Polarization: Linear vertical

Item 6 Noise Temperature of the Receiving Space Station

1750 Kelvin

Item 7 Necessary Bandwidth

For narrow-band carriers: 100 kHz.

Item 8 Modulation Characteristics

For television carriers, peak-to-peak frequency deviation is 2 MHz at a 30 Hz rate in the absence of video signals.

Section D. Characteristics of the Satellite Network in the Space-to-Earth Direction

Item 1 Space-to-Earth Service Area

The 48 contiguous states of the United States, Puerto Rico and the U.S. Virgin Islands.

Item 2 Class of Stations and Nature of Service

EC

Item 3 Frequency Range

3700 - 4200 MHz

Item 4 Power Characteristics of Transmission into the Antenna

a) Maximum power spectral density: -56.5 dB(W/Hz)
Total peak envelope power: 6.5 dB(W)
Necessary bandwidth: 36 MHz

b) Peak envelope power delivered to the antenna:
Television carriers: 6.5 dB(W)
Narrow-band carriers: -6 dB(W)

c) Minimum carrier power delivered to the antenna for narrow-band carriers: -19 dB(W)

Item 5 Characteristics of the Space Station Transmitting Antenna

a) Gain contours: See Figure 2.

c) Polarization: Linear vertical.

Item 6 Characteristics of Receiving Earth Stations

a)

	Antenna gain [dB(i)]	TEQ (K)	GAMMA (dB)
Lowest Equivalent satellite link noise temperature (TEQ) and associated transmission gain (GAMMA)	51.0	140	-20.6
	40.0	128	-27.0
Highest ratio of transmission gain (GAMMA) to equivalent satellite link noise temperature (TEQ)	51.0	300	-10.0
	40.0	139	-21.0

b) Typical radiation pattern:

Antenna sidelobes conform to:

for G = 51 dB(i): CCIR Rec. 465-1
for G = 40 dB(i): 29 - 25 log(Ø)

Item 7 Necessary Bandwidth

For narrow-band carriers the necessary bandwidth is 100 kHz.

Item 8 Modulation Characteristics

For television carriers, peak-to-peak frequency deviation is 2 MHz at a 30 Hz rate in the absence of video signals.

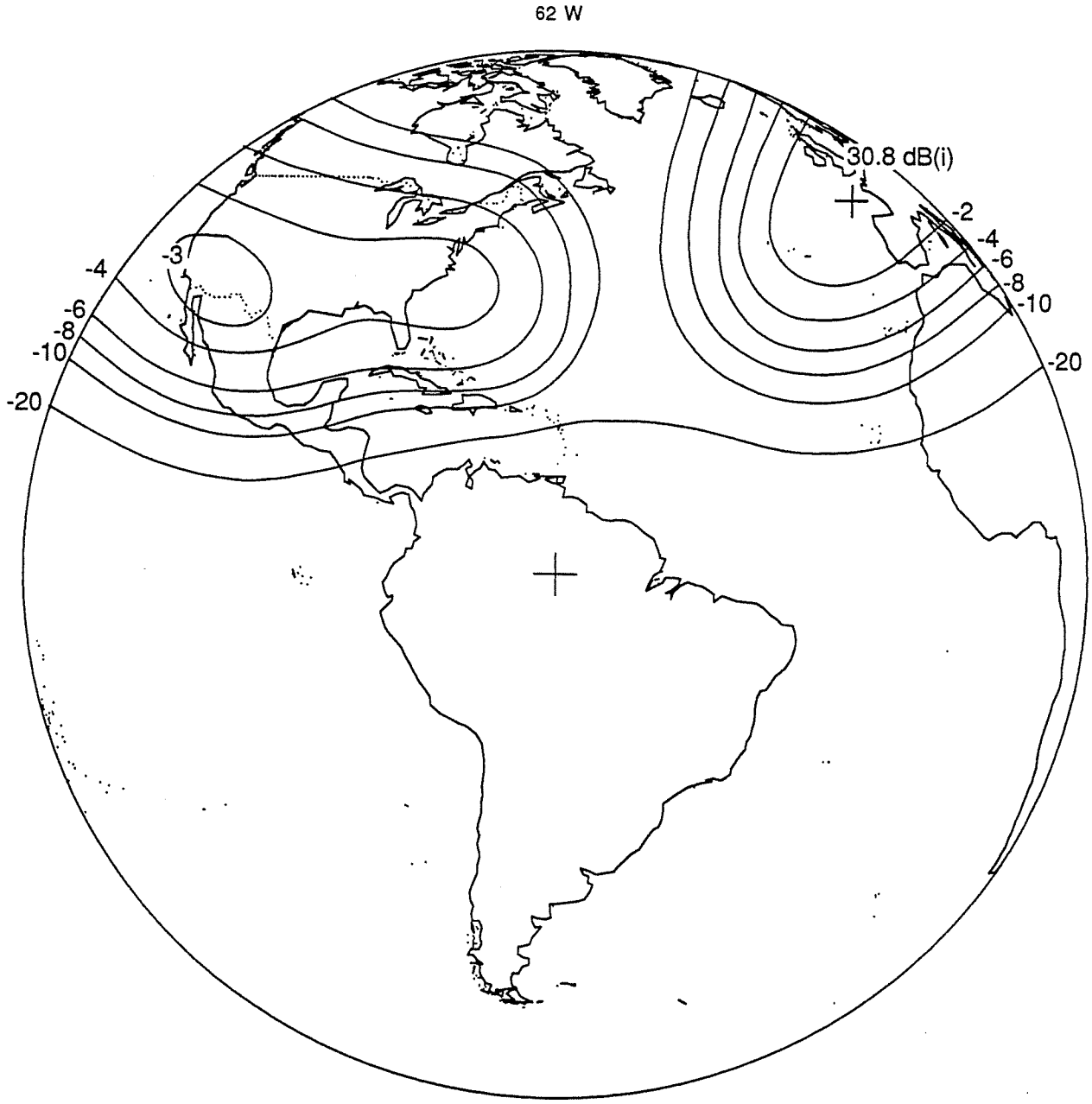


Figure 1 - Receive Gain Contours (62° W)

This Figure Includes Pointing Errors

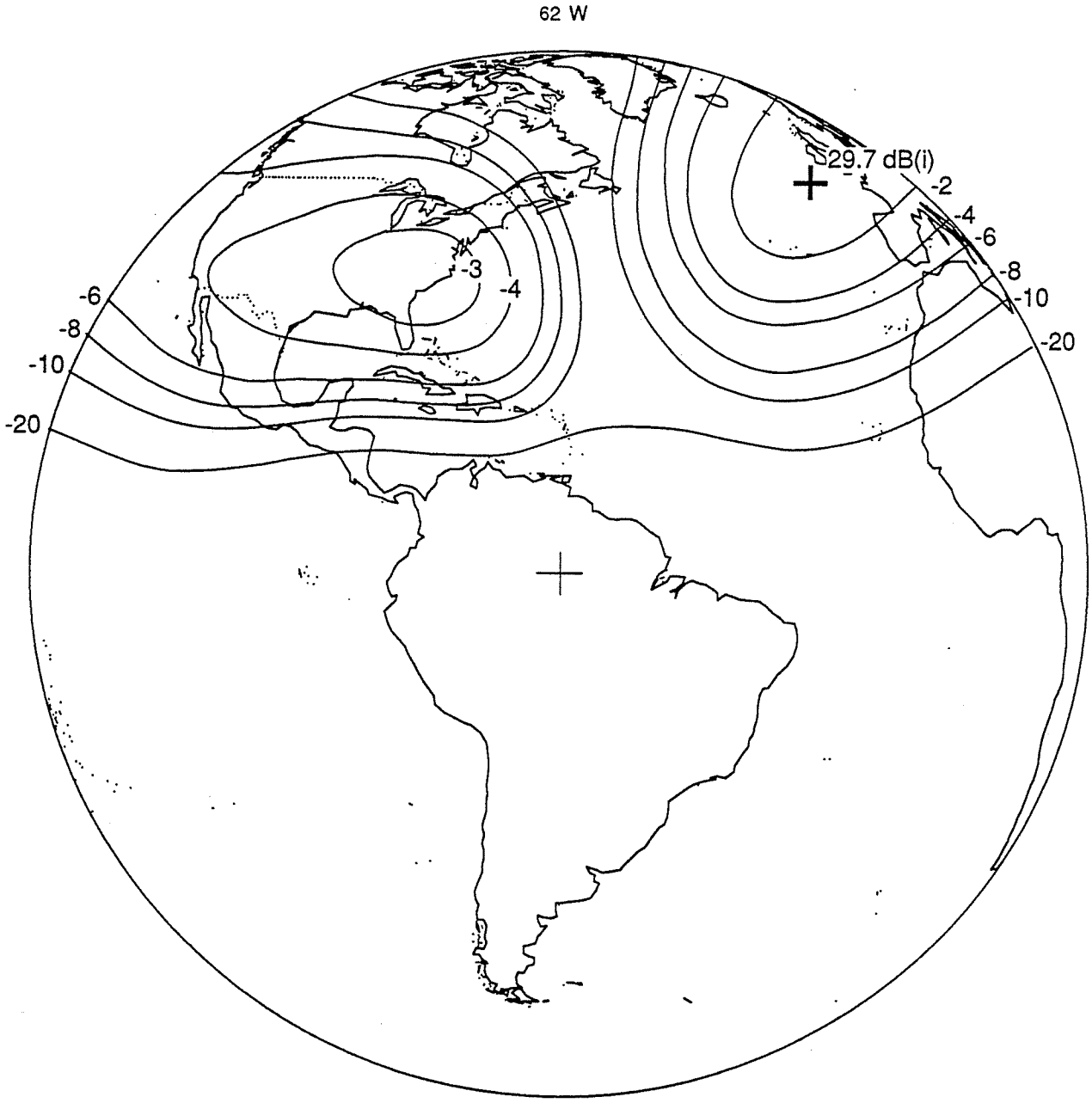


Figure 2 - Transmit Gain Contours (62° W)

This Figure Includes Pointing Errors

18 July 1989

Page 1 of 4 | Date | FORM OF NOTICE — TRANSMITTING SPACE STATION (APPENDIX 3 - SECTION D) | (For IFRB use only) | **AP3/D**

A NOTIFYING ADMINISTRATION: USA | B Administration Serial No.

C First Notification ☐ | D Resubmission ☐

E1 RR 1488 Notification ☐ | E2 RR 1060 Request for coordination ☒ | E3 Agreement under Art. 14 RR 1611/1613 ☐ | E4 Request for assistance by the Board for coord. RR 1060 ☐

F Notification intended for: ADD 1) ☒ MOD 2) ☐ SUP 3) ☐ of an assignment
Identification No.of the assignment to be modified/deleted:

CHARACTERISTICS OF THE ASSIGNMENT

1 - Assigned frequency	2 - Assigned frequency band	7a - Class of station	7b - Nature of service	7c - Ex-penm. station	3a - Date Col. 2c (Day / Mo. / Year)	12 - Reg. hours of oper. From (UTC) H / Min.	To (UTC) H / Min.
* Hz	36000 kHz	EC			31 / 12 / 92	00 / 00	24 / 00

STATION CHARACTERISTICS

4a - Name of the transmitting space station or identity of the satellite network	For geostationary satellites only: 4c - Designation of transmitting satellite beam	3b - Period of validity (Years)	10d - Pointing accuracy (Degrees ±)
USASAT	NW	15	0.3

G Special Section AR/11/A/ (RR 1042): 158

H Special Section AR/11/C/ (RR 1060):

I TYPE OF THE SPACE STATION

Geostationary operating with: earth stations 1) ☒, or another satellite 2) ☐, and with simple frequency changing transponder 3) ☒

or

Non-geostationary operating with: earth stations 4) ☐, or geostationary space station 5) ☐, or another space station 6) ☐

ORBITAL CHARACTERISTICS

FOR GEOSTATIONARY SATELLITES

5a1 - Nominal orbital longitude	5a2 - Longit. tolerance (Degrees) To West	To East	5a3 - Inclinat. excursion (Degrees)	5a4 - Visibility arc (Degrees) From W	To E	5a5 - Service arc (Degrees) From W	To E
62.0 W	0.1	0.1	0.1	135 W	60 W	70 W	60 W

Note: If the service arc (5a5) is less than the visibility arc(5a4), provide the reasons therefor in ATT. No. 4

FOR NON-GEOSTATIONARY SATELLITES

5b1 - Inclinat. angle (Degrees)	5b2 - Period (Days / D Hours / H Min.)	5b3 - Apogee (km)	5b4 - Perigee (km)	5b5 - Reference body, if other than the Earth	5b6 Number of sats.

AREA WHERE THE ASSOCIATED RECEIVING EARTH STATIONS ARE LOCATED OR ASSOCIATED RECEIVING SPACE STATION

6 - Designation, or fill in ATT. No. 7: see ATT. No. 7

CHARACTERISTICS OF ENTRIES PERTAINING TO THE ASSIGNMENT

ANTENNA CHARACTERISTICS

10 - maximum isotropic gain (± dB)
+29.7

See also:
4c - Designation of transmitting satellite beam and ATTACHMENTS Nos. 1, 2 and 3, as appropriate

FCC 130-D
JANUARY 1982

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	8a - Designation of emission	9b1 - Total peak power (± dBW)	9b2 - Max. power density (± dBW/Hz)
1				36M0F3F	+6.5	-56.5
2				30M0G1D	+6.5	-66.5
3				100KG1D	-19.0	-66.5

For additional entries use separate sheet

OTHER RELATED INFORMATION

13 - Coordination
– coordinated under RR 1060 or RR 1107 with:
– or coordination requested under RR 1060 with:

RR Provisions	Country symbols
RR 1060	USA/IT

14 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K ATT No.	Item of AP3/D	Type of the space station	Description	Tick If included
1	10a	Geostat. operating with earth stations	Antenna gain contours	X
2	10b	Geostat. operating with another satellite	Radiation Pattern	
		Non-geostationary		
3	10e	Geostationary operating in frequency bands allocated in the Earth-to-space and space-to-Earth directions	Radiation diagram versus geostat. satellite orbit	
4	5a3	Geostationary operating with earth stations	Reasons for service arc < visibility arc	X
5	8b, c, d; 9a, c; 10c; 11	All types of space stations	Information used for coordination	
6	1	All types of space stations	List of assigned frequencies for assignments with all other characteristics identical	X
7	6	All types of space stations	Service area	X

OTHER INFORMATION OR REMARKS

L

* 15a - ARC Professional Services Group, Inc

If supplied on separate sheet(s), indicate the number ☐

15a - Operating Administration or Company: *

15b - Administration responsible for the station: A

Page 2 of 4 | Date

A NOTIFYING ADMINISTRATION | B Administration Serial No.

FORM OF NOTICE
TRANSMITTING SPACE STATION
(APPENDIX 3 - SECTION D)

(For IFRB use only)

AP3/D

C First Notification ☐ | D Resubmission ☐

E1 RR 1488 Notification ☐ | E2 RR 1060 Request for coordination ☐ | E3 Agreement under Art. 14 RR 1611/1613 ☐ | E4 Request for assistance by the Board for coord. RR 1060 ☐

F Notification intended for ADD 1) ☐ MOD 2) ☐ SUP 3) ☐ of an assignment
Identification No.of the assignment to be modified/deleted

CHARACTERISTICS OF THE ASSIGNMENT

1 - Assigned frequency (k M G) Hz | 2 - Assigned frequency band kHz | 7a - Class of station | 7b - Nature of service | 7c - Ex-perm. station

3a - Date Col. 2c: Day | Mo. | Year

12 - Reg. hours of oper.: From (UTC) H | Min. — To (UTC) H | Min.

STATION CHARACTERISTICS

4a - Name of the transmitting space station or identity of the satellite network

For geostationary satellites only:
4c - Designation of transmitting satellite beam | 3b - Period of validity Years | 10d - Pointing accuracy Degrees ±

G Special Section AR/11/A/ (RR 1042)

H Special Section AR/11/C/ (RR 1060)

I TYPE OF THE SPACE STATION

Geostationary operating with: earth stations 1) ☐, or another satellite 2) ☐, and with simple frequency changing transponder 3) ☐

or

Non-geostationary operating with: earth stations 4) ☐, or geostationary space station 5) ☐, or another space station 6) ☐

ORBITAL CHARACTERISTICS

FOR GEOSTATIONARY SATELLITES

5a1 - Nominal orbital longitude (e w)

5a2 - Longit. tolerance Degrees: To West | To East

5a3 - Inclinat. excursion Degrees

5a4 - Visibility arc Degrees: From W (e w) | To E (e w)

5a5 - Service arc Degrees: From W (e w) | To E (e w)

Note: If the service arc (5a5) is less than the visibility arc(5a4), provide the reasons therefor in ATT. No. 4

FOR NON-GEOSTATIONARY SATELLITES

5b1 - Inclinat. angle Degrees

5b2 - Period: Days | D Hours — Hours | H Min.

5b3 - Apogee km

5b4 - Perigee km

5b5 - Reference body, if other than the Earth

5b6 Number of sats.

AREA WHERE THE ASSOCIATED RECEIVING EARTH STATIONS ARE LOCATED OR ASSOCIATED RECEIVING SPACE STATION

6 - Designation, or fill in ATT. No. 7

CHARACTERISTICS OF ENTRIES PERTAINING TO THE ASSIGNMENT

ANTENNA CHARACTERISTICS

10 - maximum isotropic gain ± dB

See also:
4c - Designation of transmitting satellite beam and ATTACHMENTS Nos. 1, 2 and 3, as appropriate

FCC 130-D
JANUARY 1982

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	8a - Designation of emission	9b1 - Total peak power ± dBW	9b2 - Max. power density ± dBW/Hz
4				500KG1D	- 6 0	- 60 1

For additional entries use separate sheet

OTHER RELATED INFORMATION

13 - Coordination
– coordinated under RR 1060 or RR 1107 with:
– or coordination requested under RR 1060 with:

RR Provisions	Country symbols

14 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K

ATT No.	Item of AP3/D	Type of the space station	Description	Tick if included
1	10a	Geostat. operating with earth stations	Antenna gain contours	
2	10b	Geostat. operating with another satellite	Radiation Pattern	
		Non-geostationary		
3	10e	Geostationary operating in frequency bands allocated in the Earth-to-space and space-to-Earth directions	Radiation diagram versus geostat. satellite orbit	
4	5a3	Geostationary operating with earth stations	Reasons for service arc < visibility arc	
5	8b, c, d; 9a, c; 10c; 11	All types of space stations	Information used for coordination	
6	1	All types of space stations	List of assigned frequencies for assignments with all other characteristics identical	
7	6	All types of space stations	Service area	

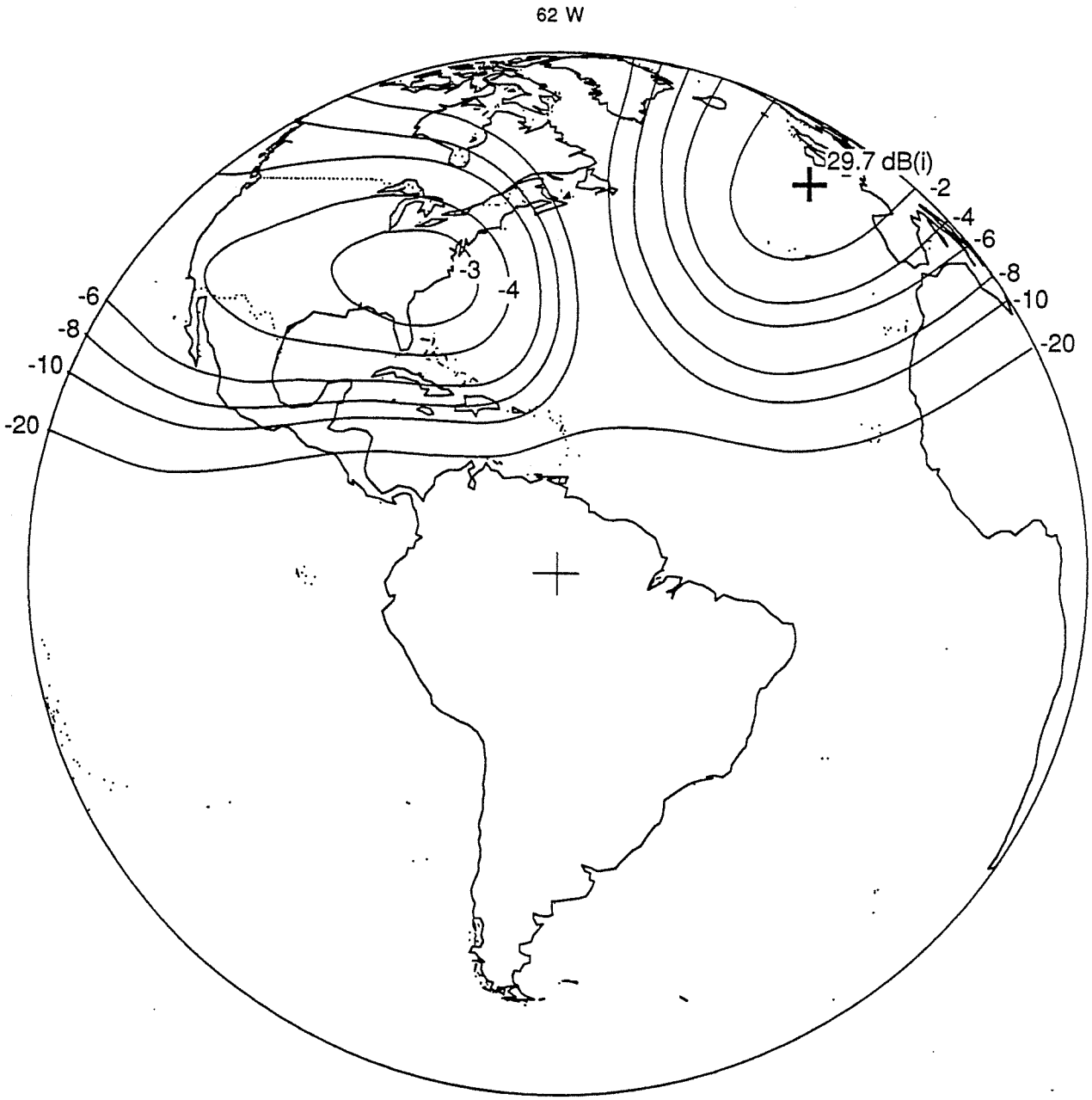
OTHER INFORMATION OR REMARKS

L

If supplied on separate sheet(s), indicate the number ☐

15a - Operating Administration or Company

15b - Administration responsible for the station



Attachment No. 1 to AP3/D

Transmit Gain Contours (62° W)

This Figure Includes Pointing Errors

ATTACHMENT No. 4 to AP3/D

Difference: Shaped beam pattern limits useful service arc.

ATTACHMENT No. 6 to AP3/D

List of assigned frequencies for assignments with all other characteristics identical:

3720 MHz
3760 MHz
3800 MHz
3840 MHz
3880 MHz
3920 MHz
3960 MHz
4000 MHz
4040 MHz
4080 MHz
4120 MHz
4160 MHz

ATTACHMENT No. 7 to AP3/D

Service area: The 48 contiguous states of the United States, Puerto Rico, U.S. Virgin Islands.

18 July 1989

Page 1 of 4 | Date

A NOTIFYING ADMINISTRATION: USA | B Administration Serial No.

FORM OF NOTICE
RECEIVING SPACE STATION
(APPENDIX 3 - SECTION E)

(For IFRB use only)

AP3/E

C First Notification ☐ | D Resubmission ☐ | E1 RR 1488 Notification ☐ | E2 RR 1060 Request for coordination ☒ | E3 Agreement under Art. 14 RR 1611/1613 ☐ | E4 Request for assistance by the Board for coord. RR 1060 ☐

F Notification intended for: ADD 1) ☒ MOD 2) ☐ SUP 3) ☐ of an assignment
Identification No. of the assignment to be modified/deleted:

CHARACTERISTICS OF THE ASSIGNMENT

1 - Assigned frequency (kMG)	2 - Assigned frequency band	7a - Class of station	7b - Nature of service	7c - Ex-penm. station	3a - Date Col. 2c (Day Mo. Year)	11 - Reg. hours of oper. From (UTC)	To (UTC)
* Hz	36000 kHz	EC			31 12 92	H. Min. 00 00	H. Min. 24 00

STATION CHARACTERISTICS

4a - Name of the receiving space station or identity of the satellite network	For Geostationary satellites only: 4c - Designation of receiving satellite beam	3b - Period of validity Years	10d - Pointing accuracy Degrees:
USASAT	NW	15	0.3

G Special Section AR/11/A/ (RR 1042): 158

H Special Section AR/11/C/ (RR 1060):

I TYPE OF THE SPACE STATION

Geostationary operating with: earth stations 1) ☒, or another satellite 2) ☐, and with simple frequency changing transponder 3) ☒

or

Non-geostationary operating with: earth stations 4) ☐, or geostationary space station 5) ☐, or another space station 6) ☐

ORBITAL CHARACTERISTICS

FOR GEOSTATIONARY SATELLITES

5a1 - Nominal orbital longitude (Degrees, E/W)	5a2 - Longit. tolerance (Degrees To West / To East)	5a3 - Inclinat. excursion (Degrees)	5a4 - Visibility arc (Degrees From W / To E)	5a5 - Service arc (Degrees From W / To E)
62.0 W	0.1 / 0.1	0.1	135 W / 60 W	70 W / 60 W

Note: If the service arc (5a5) is less than the visibility arc (5a4), provide the reasons therefor in ATT. No. 4

FOR NON-GEOSTATIONARY SATELLITES

5b1 - Inclinat. angle (Degrees)	5b2 - Period (Days D Hours / Hours H Min.)	5b3 - Apogee (km)	5b4 - Perigee (km)	5b5 - Reference body, if other than the Earth	5b6 Number of sats.

AREA WHERE THE ASSOCIATED TRANSMITTING EARTH STATIONS ARE LOCATED OR ASSOCIATED TRANSMITTING SPACE STATION

6 - Designation, or fill in ATT. No. 7: see ATT. No. 7

CHARACTERISTICS OF ENTRIES PERTAINING TO THE ASSIGNMENT

ANTENNA CHARACTERISTICS

9a - maximum isotropic gain (± dB)	See also:	10 - Receiving system noise temperature (Kelvin)
+30.8	4c - Designation of receiving satellite beam and ATTACHMENTS Nos. 1, 2 and 3, as appropriate	1750

FCC 130-E
JANUARY 1982

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	8a - Designation of emission
1				36M0F3F
2				30M0G1D
3				100KG1D

For additional entries use separate sheet

OTHER RELATED INFORMATION

12 - Coordination
– coordinated under RR 1060 or RR 1107 with:
– or coordination requested under RR 1060 with:

RR Provisions	Country symbols
RR 1060	USA/IT

13 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K ATT No.	Item of AP3/E	Type of the space station	Description	Tick If included
1	9a	Geostat. operating with earth stations	Antenna gain contours	X
2	9b	Geostat. operating with another satellite	Radiation Pattern	
		Non-geostationary		
3	9e	Geostationary operating in frequency bands allocated in the Earth-to-space and space-to-Earth directions	Radiation diagram versus geostat. satellite orbit	
4	5a3	Geostationary operating with earth stations	Reasons for service arc < visibility arc	X
5	8b, c; 9c	All types of space stations	Information used for coordination	
6	1	All types of space stations	List of assigned frequencies for assignments with all other characteristics identical	X
7	6	All types of space stations	Service area	X

OTHER INFORMATION OR REMARKS

L

* 14a - ARC Professional Services Group, Inc

If supplied on separate sheet(s), indicate the number ☐

14a - Operating Administration or Company: *

14b - Administration responsible for the station: A

Page 2 of 4 | Date | FORM OF NOTICE — RECEIVING SPACE STATION (APPENDIX 3 - SECTION E) | (For IFRB use only) | **AP3/E**

A NOTIFYING ADMINISTRATION | B Administration Serial No.

C First Notification ☐ | D Resubmission ☐

E1 RR 1488 Notification ☐ | E2 RR 1060 Request for coordination ☐ | E3 Agreement under Art. 14 RR 1611/1613 ☐ | E4 Request for assistance by the Board for coord. RR 1060 ☐

F Notification intended for ADD 1) ☐ MOD 2) ☐ SUP 3) ☐ of an assignment
Identification No.of the assignment to be modified/deleted

CHARACTERISTICS OF THE ASSIGNMENT

1 - Assigned frequency (k M G) Hz | 2 - Assigned frequency band kHz | 7a - Class of station | 7b - Nature of service | 7c - Ex-penm. station

3a - Date Col. 2c: Day | Mo. | Year

11 - Reg. hours of oper.: From (UTC) H Min. | To (UTC) H Min.

STATION CHARACTERISTICS

4a - Name of the receiving space station or identity of the satellite network

For Geostationary satellites only:
4c - Designation of receiving satellite beam

3b - Period of validity: Years

10d - Pointing accuracy: Degrees

G Special Section AR/11/A/ (RR 1042)

H Special Section AR/11/C/ (RR 1060)

I TYPE OF THE SPACE STATION

Geostationary operating with: earth stations 1) ☐ , or another satellite 2) ☐ , and with simple frequency changing transponder 3) ☐

or

Non-geostationary operating with: earth stations 4) ☐ , or geostationary space station 5) ☐ , or another space station 6) ☐

ORBITAL CHARACTERISTICS

FOR GEOSTATIONARY SATELLITES

5a1 - Nominal orbital longitude (e w)

5a2 - Longit. tolerance Degrees: To West | To East

5a3 - Inclinat. excursion Degrees

5a4 - Visibility arc Degrees: From W (e w) | To E (e w)

5a5 - Service arc Degrees: From W (e w) | To E (e w)

Note: If the service arc (5a5) is less than the visibility arc(5a4), provide the reasons therefor in ATT. No. 4

FOR NON-GEOSTATIONARY SATELLITES

5b1 - Inclinat. angle Degrees

5b2 - Period: Days D Hours | Hours H Min.

5b3 - Apogee km

5b4 - Perigee km

5b5 - Reference body, if other than the Earth

5b6 - Number of sats.

AREA WHERE THE ASSOCIATED TRANSMITTING EARTH STATIONS ARE LOCATED OR ASSOCIATED TRANSMITTING SPACE STATION

6 - Designation, or fill in ATT. No. 7

CHARACTERISTICS OF ENTRIES PERTAINING TO THE ASSIGNMENT

ANTENNA CHARACTERISTICS

9a - maximum isotropic gain ± dB

See also:
4c - Designation of receiving satellite beam and ATTACHMENTS Nos. 1, 2 and 3, as appropriate

10 - Receiving system noise temperature Kelvin

FCC 130-E
JANUARY 1982

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	8a - Designation of emission
4				500KG1D

For additional entries use separate sheet

OTHER RELATED INFORMATION

12 - Coordination
– coordinated under RR 1060 or RR 1107 with:
– or coordination requested under RR 1060 with:

RR Provisions	Country symbols

13 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K ATT No.	Item of AP3/E	Type of the space station	Description	Tick if included
1	9a	Geostat. operating with earth stations	Antenna gain contours	
2	9b	Geostat. operating with another satellite	Radiation Pattern	
		Non-geostationary		
3	9e	Geostationary operating in frequency bands allocated in the Earth-to-space and space-to-Earth directions	Radiation diagram versus geostat. satellite orbit	
4	5a3	Geostationary operating with earth stations	Reasons for service arc < visibility arc	
5	8b, c; 9c	All types of space stations	Information used for coordination	
6	1	All types of space stations	List of assigned frequencies for assignments with all other characteristics identical	
7	6	All types of space stations	Service area	

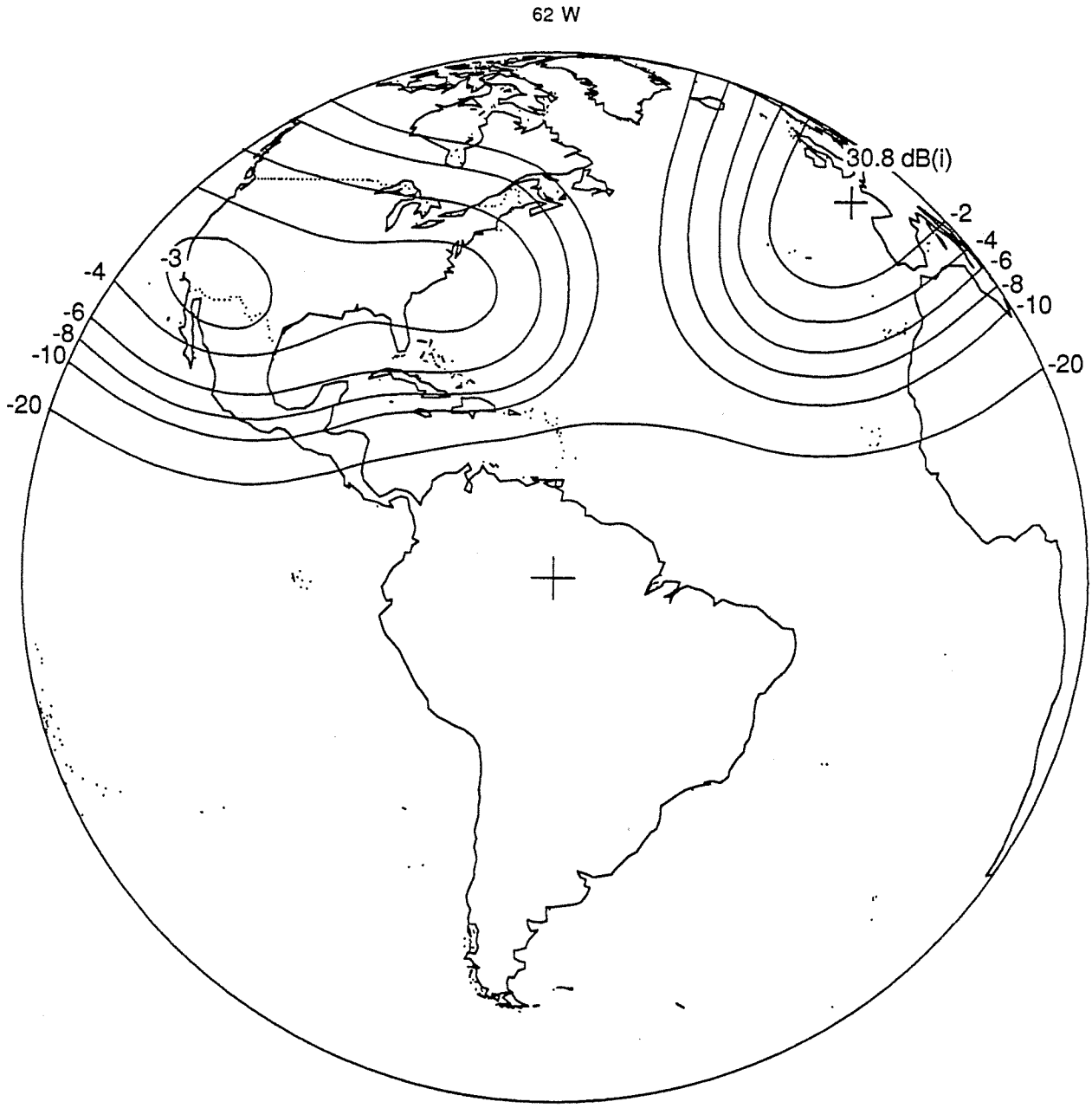
OTHER INFORMATION OR REMARKS

L

If supplied on separate sheet(s), indicate the number ☐

14a - Operating Administration or Company ☐

14b - Administration responsible for the station ☐



Attachment No. 1 to AP3/E

Receive Gain Contours (62° W)

This Figure Includes Pointing Errors

ATTACHMENT No. 4 to AP3/E

Difference: Shaped beam pattern limits useful service arc.

ATTACHMENT No. 6 to AP3/E

List of assigned frequencies for assignments with all other characteristics identical:

5945 MHz
5985 MHz
6025 MHz
6065 MHz
6105 MHz
6145 MHz
6185 MHz
6225 MHz
6265 MHz
6305 MHz
6345 MHz
6385 MHz

ATTACHMENT No. 7 to AP3/E

Service area: The 48 contiguous states of the United States, Puerto Rico, U.S. Virgin Islands.

18 July 1989

Page 1 of 2 | Date | FORM OF NOTICE | (For IFRB use only) | **AP3/B**

TRANSMITTING EARTH STATION
(APPENDIX 3 - SECTION B)

A NOTIFYING ADMINISTRATION: USA | B Administration Serial No.:

C First Notification ☐ | D Resubmission ☐

E1 RR 1488 Notification ☐ | E2 RR 1494 Notification typical mobile earth station ☐ | E3 RR 1060 Request for coordination ☒ | E4 Agreement under Art. 14 RR 1611 ☐ | E5 Request for Board assistance RR 1060 and/or E6 RR 1107 ☐

F Notification intended for: ADD 1) ☒ MOD 2) ☐ SUP 3) ☐ of an assignment
Identification No. of the assignment to be modified/deleted:

CHARACTERISTICS OF THE ASSIGNMENT

1 - Assigned frequency	2 - Assigned frequency band	6a - Class of station	6b - Nature of service	6c - Ex-perm. station	3a - Date Col. 2c (Day Mo. Year)	11 - Req. hours of oper. From (UTC) H Min. To (UTC) H Min.
* kMG Hz	36000 kHz	TC			31 12 92	00 00 24 00

STATION CHARACTERISTICS

4a - Name of the transmitting earth station	4b - Country
T1-10 METER	**

4c - Geographical coordinates

Longitude Degrees	e w	Min.	Sec.	Latitude Deg.	n s	Min.	Sec.

G Special Section AR/11/A/ (RR 1042): 158

H Special Section AR/11/C/ (RR 1060):

ASSOCIATED SPACE STATION

FOR ALL TYPES OF SPACE STATIONS:

5a - Name of the receiving space station or identity of the satellite network: USASAT

FOR GEOSTATIONARY SATELLITES ONLY:

5b - Nom. orbit long. Degrees e w: 62 0 W

5c - Designation of receiving satellite beam: NW

Fill in a separate form for each satellite beam used by the earth station

CHARACTERISTICS OF ENTRIES PERTAINING TO THE ASSIGNMENT

9a - maximum isotropic gain ± dB	9b - Beamwidth Degrees	9e - Elevat. angle Degrees	9f - Operating azimuthal angles From (Degrees)	To (Degrees)	9c - Radiation pattern: give Reference pattern, or fill in ATT. No. 2	9h - Altitude Metres
+ 54 0	0 33				CCIR 465-1	

Note: For horizon elevation diagram (9d) fill in ATT. No. 1

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	7a - Designation of emission	8b1 - Total peak power ± dBW	8b2 - Max. power density ± dBW/Hz
1				36M0F3F	+ 27 0	- 36 0
2				30M0G1D	+ 27 0	- 46 0
3				100KG1D	- 1 1	- 48 6

For additional entries use separate sheet

OTHER RELATED INFORMATION

12 - Coordination
– coordinated under RR 1060 or RR 1107 with:
– or coordination requested under RR 1060 with:

RR Provisions	Country symbols
RR 1060	USA/IT

13 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K

ATT No.	Item of AP3/B	Description	Tick if included
1	9d	Horizon elevation diagram	
2	9c	Antenna radiation diagram	
3	7b,c,d; 8 a,c; 9g; 10	Information used for coordination	
4	–	List of assigned frequencies for assignments with all other characteristics identical	X

14a - Operating Administration or Company: *

14b - Administration responsible for the station: A

OTHER INFORMATION OR REMARKS

L

* 14a - ARC Professional Services Group, Inc
** 4b - USA, PTR & VIR

If supplied on separate sheet(s), indicate the number: ☐

FCC 130-B
January 1982

ATTACHMENT No. 4 to AP3/B

List of assigned frequencies for assignments with all other characteristics identical:

5945 MHz
5985 MHz
6025 MHz
6065 MHz
6105 MHz
6145 MHz
6185 MHz
6225 MHz
6265 MHz
6305 MHz
6345 MHz
6385 MHz

18 July 1989

Page 1 of 2 | Date

A NOTIFYING ADMINISTRATION: USA | B Administration Serial No.

FORM OF NOTICE
TRANSMITTING EARTH STATION
(APPENDIX 3 - SECTION B)

(For IFRB use only)

AP3/B

C First Notification ☐ | D Resubmission ☐

E1 RR 1488 Notification ☐

E2 RR 1494 Notification typical mobile earth station ☐

E3 RR 1060 Request for coordination ☒

E4 Agreement under Art. 14 RR 1611 ☐

E5 Request for Board assistance RR 1060 and/or

E6 RR 1107

F Notification intended for ADD 1) ☒ MOD 2) ☐ SUP 3) ☐ of an assignment

Identification No.of the assignment to be modified/deleted

CHARACTERISTICS OF THE ASSIGNMENT

1 - Assigned frequency: * kHz MHz GHz

2 - Assigned frequency band: 36000 kHz

6a -Class of station: TC

6b-Nature of service:

6c-Ex-perim. station:

3a - Date Col. 2c: Day 31 | Mo. 12 | Year 92

11 - Req. hours of oper.: From (UTC) H 00 Min. 00 | To (UTC) H 24 Min. 00

STATION CHARACTERISTICS

4a - Name of the transmitting earth station: T2-5 METER

4b-Country: **

4c -Geographical coordinates

Longitude				Latitude			
Degrees	E/W	Min.	Sec.	Deg.	N/S	Min.	Sec.

G Special Section AR/11/A/ (RR 1042): 158

H Special Section AR/11/C/ (RR 1060):

ASSOCIATED SPACE STATION

FOR ALL TYPES OF SPACE STATIONS:

5a - Name of the receiving space station or identity of the satellite network: USASAT

FOR GEOSTATIONARY SATELLITES ONLY:

5b - Nom. orbit long. Degrees: 62 0 E/W: W

5c - Designation of receiving satellite beam: NW

Fill in a separate form for each satellite beam used by the earth station

CHARACTERISTICS OF ENTRIES PERTAINING TO THE ASSIGNMENT

9a - maximum isotropic gain: ± dB: + 48.0

9b - Beamwidth: Degrees: 0.65

9e - Elevat. angle: Degrees:

9f - Operating azimuthal angles: From (Degrees): | To (Degrees):

9c - Radiation pattern: give Reference pattern, or fill in ATT. No. 2: CCIR 465-1

9h - Altitude: Metres:

Note:

For horizon elevation diagram (9d) fill in ATT. No. 1

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	7a - Designation of emission	8b1 - Total peak power ± dBW	8b2 - Max. power density ± dBW/Hz
1				500KG1D	+ 15.9	- 38.2

For additional entries use separate sheet

OTHER RELATED INFORMATION

12 - Coordination
-- coordinated under RR 1060 or RR 1107 with:
-- or coordination requested under RR 1060 with:

RR Provisions	Country symbols
RR 1060	USA/IT

13 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K

ATT No.	Item of AP3/B	Description	Tick if included
1	9d	Horizon elevation diagram	
2	9c	Antenna radiation diagram	
3	7b,c,d; 8 a,c; 9g; 10	Information used for coordination	
4	-	List of assigned frequencies for assignments with all other characteristics identical	X

OTHER INFORMATION OR REMARKS

L

* 14a - ARC Professional Services Group, Inc

** 4b - USA, PTR & VIR

If supplied on separate sheet(s), indicate the number ☐

14a - Operating Administration or Company: *

14b - Administration responsible for the station: A

FCC 130-B
January 1982

ATTACHMENT No. 4 to AP3/B

List of assigned frequencies for assignments with all other characteristics identical:

5945 MHz
5985 MHz
6025 MHz
6065 MHz
6105 MHz
6145 MHz
6185 MHz
6225 MHz
6265 MHz
6305 MHz
6345 MHz
6385 MHz

18 July 1989

Page 1 of 2 | Date | FORM OF NOTICE — RECEIVING EARTH STATION (APPENDIX 3 - SECTION C) | (For IFRB use only) | **AP3/C**

A NOTIFYING ADMINISTRATION: USA | B Administration Serial No.

C First Notification ☐ | D Resubmission ☐

E1 RR 1488 Notification ☐ | E2 RR 1494 Notification typical mobile earth station ☐ | E3 RR 1060 Request for coordination ☒ | E4 Agreement under Art. 14 RR 1611 ☐ | E5 Request for Board assistance RR 1060 and/or ☐ | E6 RR 1107 ☐

F Notification intended for: ADD 1) ☒ | MOD 2) ☐ | SUP 3) ☐ of an assignment

Identification No.of the assignment to be modified/deleted:

CHARACTERISTICS OF THE ASSIGNMENT

1 - Assigned frequency	kMG	2 - Assigned frequency band	6a -Class of station	6b-Nature of service	6c-Ex-perim. station	3a - Date Col. 2c (Day Mo. Year)	10 - Req. hours of oper. From (UTC) H Min.	To (UTC) H Min.
*	Hz	36000 kHz	TC			31 12 92	00 00	24 00

STATION CHARACTERISTICS

4a - Name of the receiving earth station	4b-Country
T1-10 METER	**

4c -Geographical coordinates	Longitude Degrees	e w	Min.	Sec.	Latitude Deg.	n s	Min.	Sec.

G Special Section AR/11/A/ (RR 1042): 158

H Special Section AR/11/C/ (RR 1060):

ASSOCIATED SPACE STATION

FOR ALL TYPES OF SPACE STATIONS:

5a - Name of the transmitting space station or identity of the satellite network: USASAT

FOR GEOSTATIONARY SATELLITES ONLY:

5b - Nom. orbit long. Degrees: 62 0 W

5c - Designation of transmiting satellite beam: NW

Fill in a separate form for each satellite beam used by the earth station

CHARACTERISTICS OF ENTRIES PERTAINING TO THE ASSIGNMENT

8a - maximum isotropic gain ± dB	8b - Beamwidth Degrees	8e - Elevat. angle Degrees	8f - Operating azimuthal angles From (Degrees)	To (Degrees)	8c - Radiation pattern: give Reference pattern, or fill in ATT. No. 2	8g - Altitude Metres	9a-Receiving system noise (emperature Kelvin
+ 51,0	0,46				CCIR 465-1		125

Note: For horizon elevation diagram (8d) fill in ATT. No. 1

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	7a - Designation of emission	9b - Satellite link noise temperature Kelvin	9c - Trans-mission gain ± dB
1				36M0F3F	141	- 20,5
2				30M0G1D	141	- 20,5
3				100KG1D	140	- 20,6

For additional entries use separate sheet

9b + 9c only for geostationary space stations with simple frequency changing transponder

OTHER RELATED INFORMATION

11 - Coordination
– coordinated under RR 1060 or RR 1107 with:
– or coordination requested under RR 1060 with:

RR Provisions	Country symbols
RR 1060	USA/IT

12 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K ATT No.	Item of AP3/C	Description	Tick if included
1	8d	Horizon elevation diagram	
2	8c	Antenna radiation diagram	
3	7b, c; 8h	Information used for coordination	
4	–	List of assigned frequencies for assignments with all other characteristics identical	X

OTHER INFORMATION OR REMARKS

L

* 13a - ARC Professional Services Group, Inc

** 4b - USA, PTR & VIR

If supplied on separate sheet(s), indicate the number ☐

13a - Operating Administration or Company: *

13b - Administration responsible for the station: A

FCC 130-C
January 1982

ATTACHMENT No. 4 to AP3/C

List of assigned frequencies for assignments with all other characteristics identical:

3720 MHz
3760 MHz
3800 MHz
3840 MHz
3880 MHz
3920 MHz
3960 MHz
4000 MHz
4040 MHz
4080 MHz
4120 MHz
4160 MHz

18 July 1989

Page 1 of 2 | Date | FORM OF NOTICE — RECEIVING EARTH STATION (APPENDIX 3 - SECTION C) | (For IFRB use only) | **AP3/C**

A NOTIFYING ADMINISTRATION: USA | B Administration Serial No.

C First Notification ☐ | D Resubmission ☐

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F Notification intended for ADD 1) ☒ MOD 2) ☐ SUP 3) ☐ of an assignment

Identification No. of the assignment to be modified/deleted

CHARACTERISTICS OF THE ASSIGNMENT

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*	Hz	36000 kHz	TC			31 12 92	00 00 24 00

STATION CHARACTERISTICS

4a - Name of the receiving earth station	4b-Country
T2-3 METER	**

4c - Geographical coordinates

Longitude Degrees	e/w	Min.	Sec.	Latitude Deg.	n/s	Min.	Sec.

G Special Section AR/11/A/ (RR 1042): 158

H Special Section AR/11/C/ (RR 1060):

ASSOCIATED SPACE STATION

FOR ALL TYPES OF SPACE STATIONS:

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FOR GEOSTATIONARY SATELLITES ONLY:

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+ 40 0	1 64				29-25LOG(FI)		125

Note: For horizon elevation diagram (8d) fill in ATT. No. 1

CHARACTERISTICS SPECIFIC FOR EACH ENTRY

J

1) Entry No.	2) ADD	3) MOD	4) SUP	7a - Designation of emission	9b - Satellite link noise temperature Kelvin	9c - Trans-mission gain ± dB
1				500KG1D	128	- 27 0

For additional entries use separate sheet

9b + 9c only for geostationary space stations with simple frequency changing transponder

OTHER RELATED INFORMATION

11 - Coordination
– coordinated under RR 1060 or RR 1107 with:
– or coordination requested under RR 1060 with:

RR Provisions	Country symbols
RR 1060	USA/IT

12 - Agreements with respect to other provisions of the RR

RR Provisions	Country symbols

ATTACHMENTS

K

ATT No.	Item of AP3/C	Description	Tick If included
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3	7b, c; 8h	Information used for coordination	
4	-	List of assigned frequencies for assignments with all other characteristics identical	X

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FCC 130-C
January 1982

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List of assigned frequencies for assignments with all other characteristics identical:

3720 MHz
3760 MHz
3800 MHz
3840 MHz
3880 MHz
3920 MHz
3960 MHz
4000 MHz
4040 MHz
4080 MHz
4120 MHz
4160 MHz

ARC Professional Services
Group, Inc.
Application for TDRS-5
at 62° W.L.
January, 1990

APPENDIX 3

Cost Estimate for Operation of C-Band Capacity on TDRS-5
and
Consolidated Balance Sheet for
Sequa Corporation
Including its Subsidiary,
ARC Professional Services
Group, Inc.
as of December 31, 1988

ARC has ample financial resources available to it for full implementation of its proposed provision of domestic service using the C-band capacity on TDRS-5. A pro-forma four year statement describing estimated investment costs and operating expenses (in thousands of dollars) is provided below:

PRO-FORMA STATEMENT
OF USES OF FUNDS FOR
ARC TDRS-5 C-BAND SERVICE

	1990	1991	1992	1993
Purchase of Control Earth Station Equipment	$1,250	0	0	0
Costs of Designing, Managing and Operating TDRS-5 C-band System and Providing Transponder Service	450	500	500	500

It should be noted that the Commission has issued ARC's predecessor in interest an STA to operate TDRS-1 at 62° W.L. The difference in cost of operating TDRS-5 instead of operating TDRS-1 at 62° W.L. is minimal. The total cost of managing the system in 1991 (the first year of operation of TDRS-5 at 62° W.L.) is estimated at $1.7 million.

As can be seen from the attached financial statements of Sequa Corporation, the parent corporation of which ARC is a 100% subsidiary (through an intervening corporation, Atlantic Research Corporation), ARC has ample assets to cover these costs.

my/jge02(1)proforma

CONSOLIDATED BALANCE SHEET

Sequa Corporation and Subsidiaries

At December 31,			1988	1987
Amounts in thousands	Operations, excluding Financial Services	Financial Services	Consolidated Total	Consolidated Total
ASSETS				
Current assets				
Cash and cash equivalents	$ 60,124	$ 4,050	**$ 64,174**	$ 48,203
Short-term investments	4,659	—	**4,659**	39,290
Receivables (less allowances of $5,840 and $6,118)	183,446	12,012	**195,458**	246,551
Unbilled receivables, net (Note 6)	84,438	—	**84,438**	75,139
Inventories (Note 7)	250,486	—	**250,486**	207,081
Net assets of discontinued operations	115,589	—	**115,589**	140,787
Investment in leasing assets (Note 9)	—	31,709	**31,709**	12,752
Other current assets	37,656	2,141	**39,797**	46,224
Total current assets	736,398	49,912	**786,310**	816,027
Investments				
Investment in leasing assets (Note 9)	—	238,153	**238,153**	101,913
Non-current receivables	15,669	33,285	**48,954**	41,172
Other investments	616	22,521	**23,137**	20,758
	16,285	293,959	**310,244**	163,843
Property, plant and equipment, net (Note 8)	422,519	21,501	**444,020**	407,316
Other assets				
Deferred charges and other	14,940	1,111	**16,051**	15,000
Excess of cost over net assets of companies acquired (Note 2)	402,462	—	**402,462**	365,952
	417,402	1,111	**418,513**	380,952
Total assets	$1,592,604	$366,483	**$1,959,087**	$1,768,138

The accompanying notes are an integral part of the financial statements.

At December 31,			1988	1987
Amounts in thousands, except share data	Operations, excluding Financial Services	Financial Services	Consolidated Total	Consolidated Total
LIABILITIES AND SHAREHOLDERS' EQUITY				
Current liabilities				
Bank loans and notes payable (Note 10)	$ 43,113	$ —	**$ 43,113**	$ 49,528
Current maturities of long-term debt (Note 10)	23,803	14,113	**37,916**	50,352
Accounts payable	121,462	18,796	**140,258**	133,011
Taxes on income (Note 11)	952	(355)	**597**	7,658
Accrued expenses (Note 14)	183,774	18,539	**202,313**	213,161
Total current liabilities	373,104	51,093	**424,197**	453,710
Long-term debt, net of current maturities (Note 10)	464,529	166,238	**630,767**	507,058
Deferred taxes and other liabilities				
Deferred taxes on income (Note 11)	14,004	37,085	**51,089**	35,753
Other liabilities	116,634	35,909	**152,543**	97,584
	130,638	72,994	**203,632**	133,337
Shareholders' equity (Notes 10, 12 and 17)				
Preferred stock — $1 par value, 1,825,000 shares authorized; 797,000 shares and 797,000 shares of $5 cumulative convertible stock issued at December 31, 1988 and 1987, respectively (involuntary liquidation value — $33,171 at December 31, 1988)			**797**	797
Class A common stock — no par value, 25,000,000 shares authorized; 7,042,000 shares and 7,043,000 shares issued at December 31, 1988 and 1987, respectively			**7,042**	7,043
Class B common stock — no par value, 5,000,000 shares authorized; 3,873,000 shares and 3,883,000 shares issued at December 31, 1988 and 1987, respectively			**3,873**	3,883
Capital in excess of par value			**302,929**	303,433
Cumulative translation adjustment			**4,352**	11,436
Retained earnings			**418,317**	359,629
			737,310	686,221
Less: cost of treasury stock			**36,819**	12,218
Total shareholders' equity	624,333	76,158	**700,491**	674,003
Total liabilities and shareholders' equity	$1,592,604	$366,483	**$1,959,087**	$1,768,138

REPORT OF INDEPENDENT PUBLIC ACCOUNTANTS

To the Shareholders and
the Board of Directors,
Sequa Corporation:

We have audited the accompanying consolidated balance sheet of Sequa Corporation (a Delaware corporation) and subsidiaries as of December 31, 1988 and 1987, and the related consolidated statements of income, shareholders' equity and cash flows for each of the three years in the period ended December 31, 1988. These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audits. The Company's equity in net income, including discontinued operations, of Chromalloy American Corporation was $12,945,000 for the year ended December 31, 1986. We did not audit the consolidated financial statements of Chromalloy American Corporation that are reflected in the accompanying consolidated financial statements using the equity method of accounting. These statements were audited by other auditors whose report has been furnished to us and our opinion, insofar as it relates to the amount included for Chromalloy American Corporation, is based solely on the report of the other auditors.

We conducted our audits in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, based on our audits and the report of other auditors, the financial statements referred to above present fairly, in all material respects, the financial position of Sequa Corporation and subsidiaries as of December 31, 1988 and 1987, and the results of their operations and their cash flows for each of the three years in the period ended December 31, 1988, in conformity with generally accepted accounting principles.

As explained in Note 1 to the financial statements, the Company has given retroactive effect to the change in accounting for its wholly-owned Financial Services subsidiaries, which had previously been accounted for by the equity method.

Arthur Andersen & Co.

New York, New York
March 17, 1989

QUARTERLY STOCK PRICE DATA

Shares of Sequa Class A common stock and Sequa Class B common stock are listed on the New York Stock Exchange. The following table sets forth the high and low sales prices of these stocks for the calendar periods indicated on the Exchange Composite Tape, as reported by the National Quotation Bureau Incorporated.

	Sequa Class A		Sequa Class B	
	High	Low	High	Low
1987				
First Quarter	79½	69	82	72¼
Second Quarter	78⅜	72⅛	79¼	75
Third Quarter	88⅜	71	91⅛	73¼
Fourth Quarter	57	41	88½	43¼
1988				
First Quarter	68	51	70½	52
Second Quarter	65⅝	60¼	71¼	63½
Third Quarter	67	60	70¼	63
Fourth Quarter	65¾	57⅛	69½	62

ARC Professional Services
Group, Inc.
Application for STA for
TDRS-5
January, 1990

APPENDIX 4

Technical Qualifications

Appendix 4 - Technical Qualifications

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ARC Professional Services Group, Inc.

Technical Qualifications To Provide
Domestic Service Via TDRS-5 at 62° W.L.

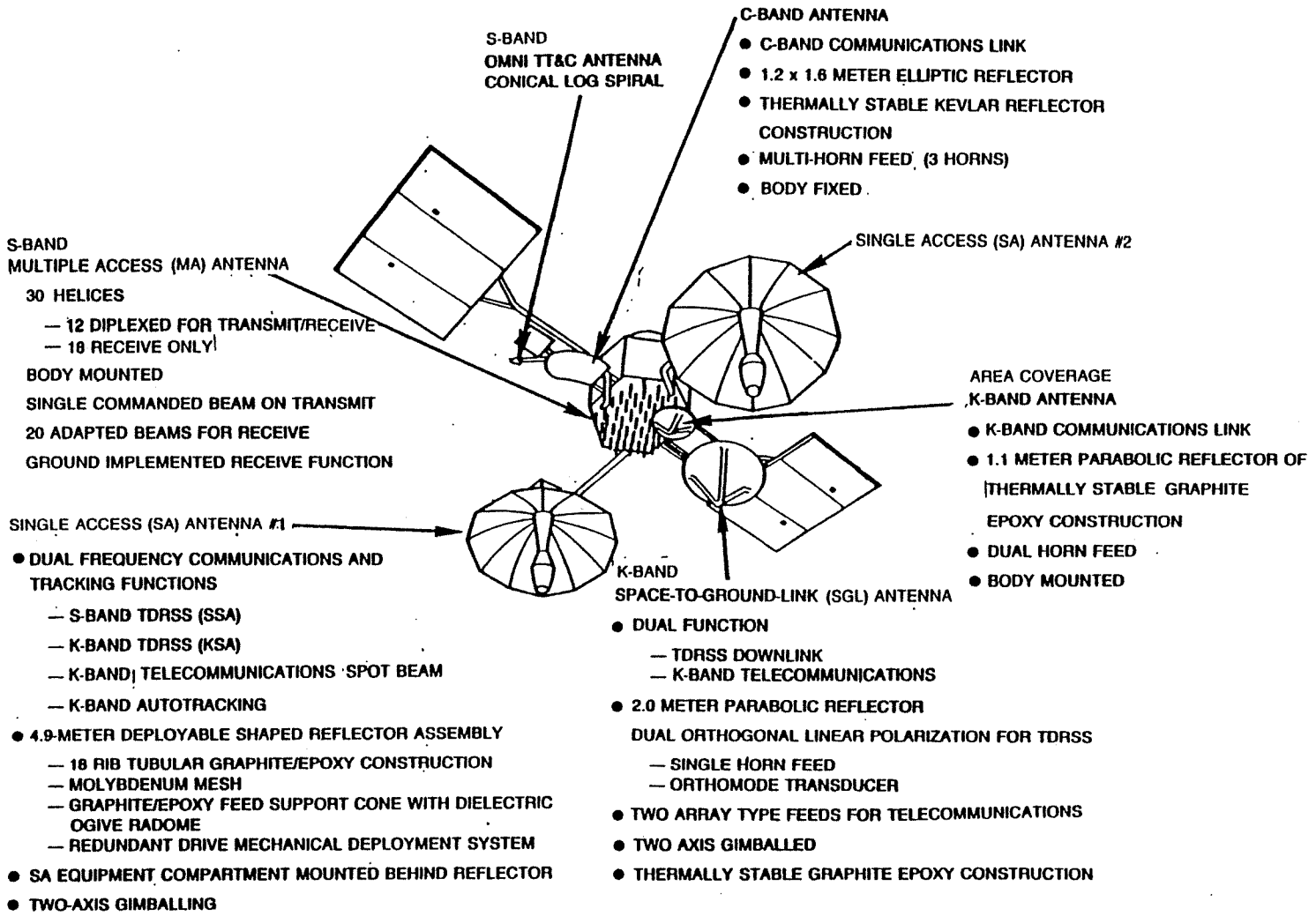
1. Introduction

ARC Professional Services Group, Inc. (ARC) is applying for special temporary authority to operate a domestic communications satellite in the 4- and 6-GHz bands and to locate that satellite at 62° West Longitude ("W.L.").

2. General Description

The TDRSS satellite illustrated in Figure 1 contains NASA S-band and K-band data relay service equipment as well as S-band and K-band TT&C equipment in addition to the C-band transponders which are the subject of this request.

The C-band transponder complement consists of twelve 36 MHz transponders having a nominal 36 dBW maximum EIRP (32.5 dBW EIRP over the continental U.S.). The satellite is intended to be launched by the Space Transportation System (STS), also called the Space Shuttle, in conjunction with the Boeing Inertial Upper Stage (IUS), which is capable of launching 5,000 pounds into geostationary orbit.



Antenna Subsystem

Figure 1

The satellite is three axis stabilized. Attitude is maintained by a combination of earth sensors, gyros, inertia wheels, and hydrazine thrusters. The hydrazine thrusters also provide the means for stationkeeping.

The in-orbit TDRS system for NASA's Tracking and Data Relay function will be comprised of three satellites, two to provide near global K-band and S-band coverage of low orbit satellites and a third, which will be an in-orbit spare. Because of operational considerations related to NASA activities and the need to serve all three satellites from NASA's main TT&C station at White Sands, N.M., the location of the two operational TDRS satellites must be located at 41° W.L. and 171° W.L. The third in-orbit TDRS spare may be at any position in between. All three TDRS satellites are considered operational (no in-orbit spare) from the viewpoint of 4/6 GHz (C-band) operation, which is the subject of this request. The satellite which is the subject of this request is the middle satellite which will serve as the spare for TDRS purposes. It will be located at 62° W.L.1/

1/ Construction of the commercial portion of the TDRS system was originally authorized in Western Union Telegraph Company, 86 F.C.C. 2d 196 (1981). There the Commission authorized the construction of the commercial portions of five complete TDRS/Advanced Westar space stations, the construction of components for a sixth TDRS/Advanced Westar space station, and the construction of parts for a seventh TDRS/Advanced Westar space station. Aside from the three TDRS spacecraft which will form the in-orbit part of the TDRS system, a fourth TDRS satellite was lost in the

International TDRS C-band coverage will be accomplished by two in-orbit satellites located at 41° W.L. (TDRS-4) and 171° W.L. (TDRS-3). TDRS-1, at 79° W.L. is currently the in-orbit spare satellite for the TDRS system. However, when TDRS-5 is launced in January, 1991, it will replace TDRS-1 as the primary in-orbit spare. TDRS-1 will be retained in-orbit at the 79° W.L. location.

3. Number and Location of Earth Stations

An indeterminate number of receive-only, transmit/receive or transmit-only earth stations will be installed initially in the United States within the coverage area of the satellite's antenna pattern.

An existing TDRS Control Ground Station for the entire TDRS system is located at White Sands, N.M. and uses encrypted links at Ku- or S-band for all control and telemetry (including the C-band transponders). Control and telemetry functions pertaining to the C-band transponders must employ these links. This

---

Challenger explosion. The fifth TDRS satellite is the subject of the instant application. The partially constructed sixth and seventh TDRS satellites, whose construction was authorized in Western Union Telegraph Company, supra, are on-ground spares for the TDRS system. However, ARC is not at this time seeking any authorizations with respect to the commercial portion of these on-the-ground spare TDRS satellites.

control ground station has no C-band receive or transmit capability.

The ARC C-band monitoring and control earth station will be connected to the TDRS Control Ground Station via a dedicated communication link to provide for the C-band telemetry and control functions to be exercised by ARC.

The TT&C earth station design concept features redundant elements in the transmitting and receiving systems to maintain monitoring and control of functions in the event specific system elements fail. Adequate spares will be on hand to enable rapid changeout of defective components.

4. Launch Vehicle

NASA intends to launch the satellite using NASA's Space Transportation System (Shuttle) in January 1991, and position it at 62° W.L.

5. Tracking, Telemetry and Control

The TDRSS TT&C system is fully encrypted and can only be operated via the existing TDRS Control Ground Station at White Sands, N.M. It operates on government frequencies at Ku-band with an S-band backup. The operating frequencies, polarization,

bandwidth and power into the antenna are covered by a government allocation. No separate TT&C link for C-band service is required (or possible). C-band operations will be controlled by ARC through its monitoring and control earth station. ARC will have the capability to turn the TDRS C-band transponders on and off through a communications interface with the Spacecom-operated TDRS Control Ground Station.

6. Radio Frequency Plan and Transponder Technical Characteristics

The radio frequency utilization plan involves transponder reception in the 5.925-6.425 GHz band with retransmission in the 3.700-4.200 GHz band. The payload consists of twelve 36 MHz transponders of a capability equivalent to those employed in the Westar series of domestic communication satellites. Signals are received at the satellite through an offset-fed shaped beam reflector antenna in the 5.925 to 6.425 GHz frequency band using linear vertical polarization. The signals are then amplified and frequency translated to the 3.7 to 4.2 GHz band and broadcast via the same antenna using linear horizontal polarization. Frequency assignments for the twelve channels are given in Table 1. Guard bands of 4 MHz are provided between channels, as illustrated in Figure 2.

As previously noted on page 3 of this Appendix, telemetry and telecommand functions are combined with the overall TDRS TT&C links from the existing TDRS Control Ground Station and are therefore not a part of this request.

The design of the TDRS C-band transponders does not provide for a separate beacon at C-band. The transmit capability of the ARC control and monitoring station will be used to provide a temporary beacon signal for C-band users within the bandwidth of a particular transponder on a temporary, as-needed basis.

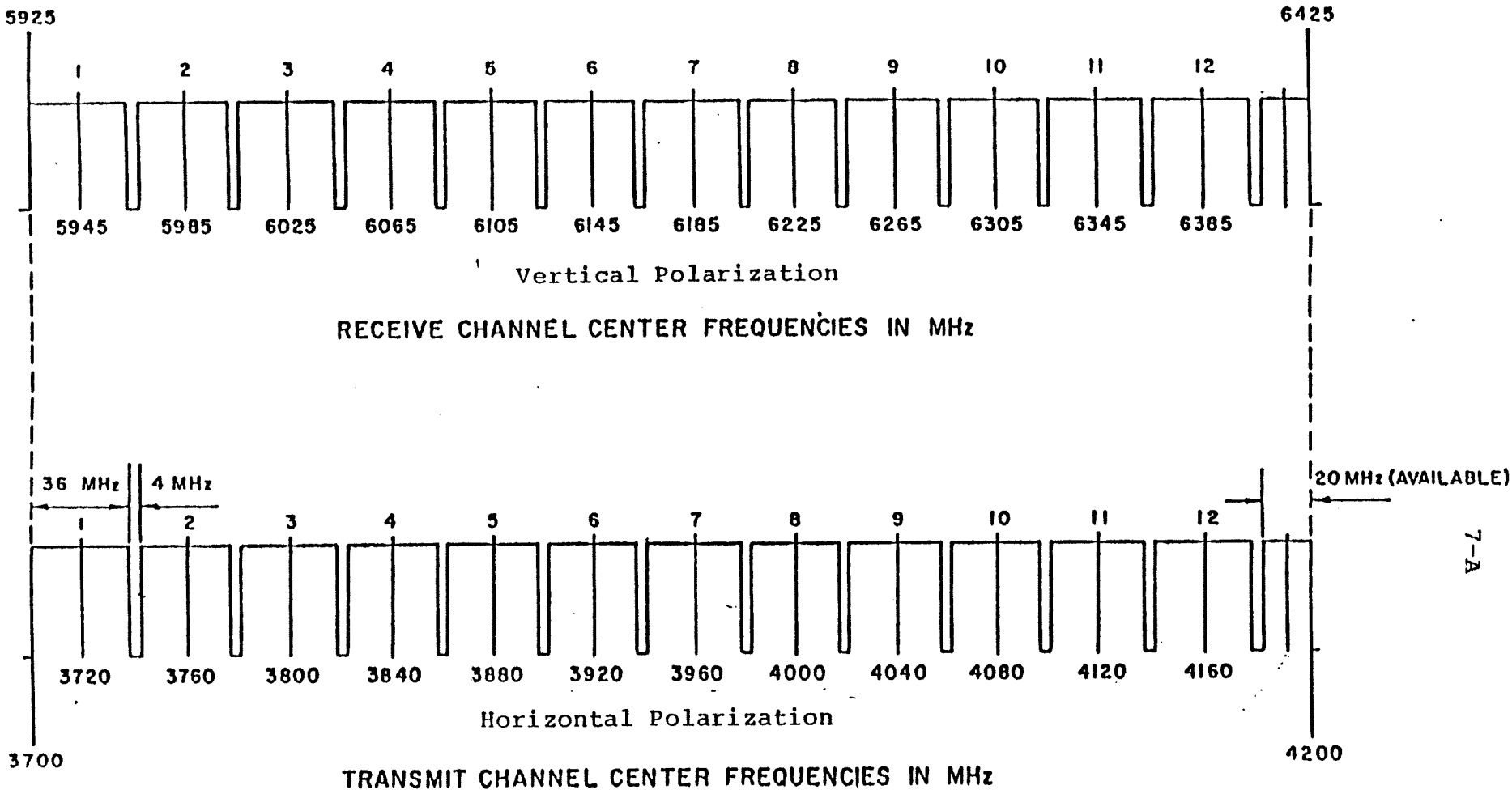
Table 1

C-band Frequency Assignments

Channel Number	Receive Frequency (MHz)	Transmit Frequency (MHz)
1	5927-5963	3702-3738
2	5967-6003	3742-3778
3	6007-6043	3782-3818
4	6047-6083	3822-3858
5	6087-6123	3862-3898
6	6127-6163	3902-3938
7	6167-6203	3942-3978
8	6207-6243	3982-4018
9	6247-6283	4022-4058
10	6287-6323	4062-4098
11	6327-6363	4102-4138
12	6367-6403	4142-4178

The emission designators applicable to the C-band transponder depend on the type of traffic being carried. Based on current traffic estimates the following emission designators would apply:

TV/FM:	36M0F3F
Digital QPSK:	30M0G1D
SCPC/FM:	50K0F3E
Digital SCPC:	100KG1D



C-BAND FREQUENCY AND POLARIZATION PLAN

Figure 2 GuardBands

The C-band saturated transmitter output is 7.4 dBW at End of Life (EOL). The multiplexer line loss channel is 0.9 dB producing 6.5 dBW maximum available at the antenna system input port. The satellite receiver temperature is 1750°K.

7. Calculation of Power Flux Density

Table 2 presents, for each type of service, the power flux density generated at the earth's surface by the TDRS C-band operations. As can be seen, none of the links violates the limits specified in FCC rule 25.208(a).

Table 2

Calculation of Maximum Power Flux Density Levels

	TV/FM	Digital	SCPC-PSK	SCPC-FM
Satellite EIRP	34.8	35.8	1.8	2.8
Bandwidth (MHz)	2[1]/	29.0	0.100	0.050
EIRP/4 kHz	7.8	-2.8	-12.2	-8.2
Spreading Loss (dB)[2]/	-162.0	-162.0	-162.0	-162.0
Power Flux Density ($dBW/m^2/4$ kHz	-154.2	164.8	-174.2	-170.2

1/ Energy dispersal bandwidth
2/ Minimum Value (nadir)

The nominal small signal transponder gain from receiver input to transponder output is 106.5 dB. No adjustable gain steps are provided. Frequency response of the transponder is governed principally by the input and output multiplexers.

The specified input frequency response for the transponders is illustrated in Figure 3. The specified output frequency response is illustrated in Figure 4.

Typical frequency response of the input frequency multiplexer is illustrated in Figure 5.

Typical frequency response of the output frequency multiplexer is illustrated in Figure 6.

Typical frequency response of the transponder is illustrated in Figure 7.

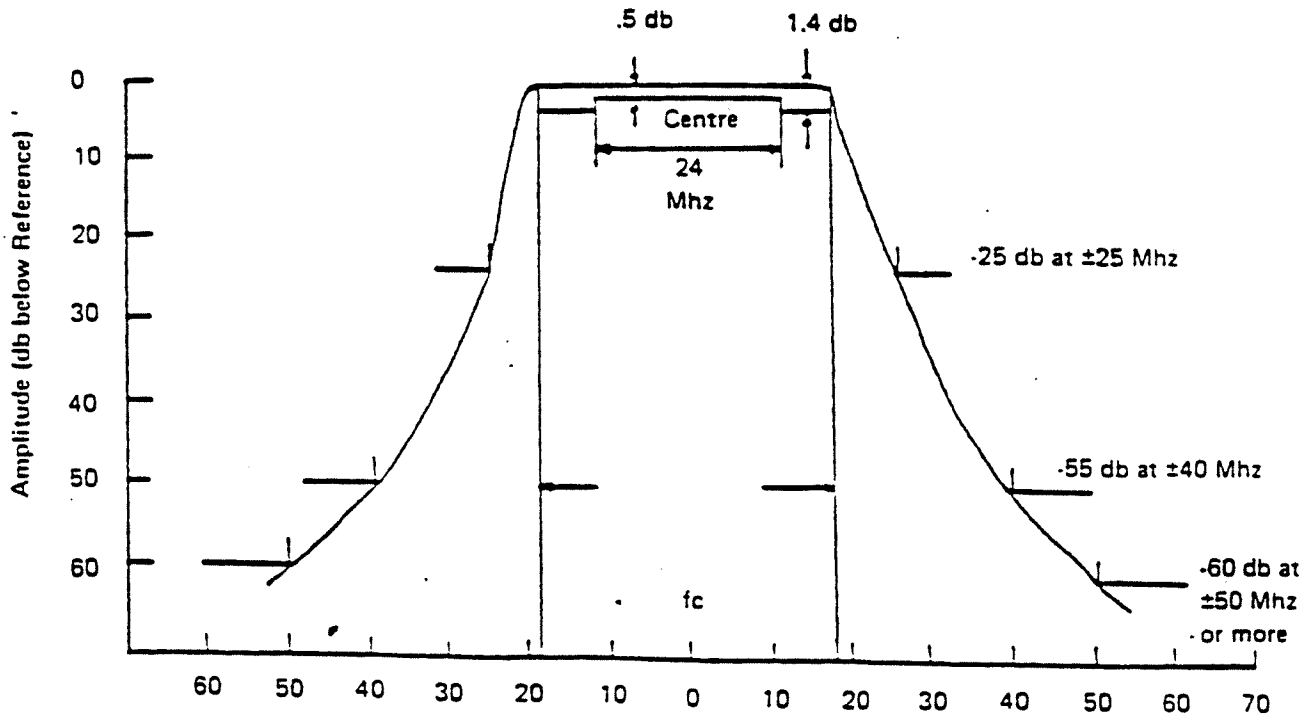


Figure Specified Input Frequency Response

Figure 3

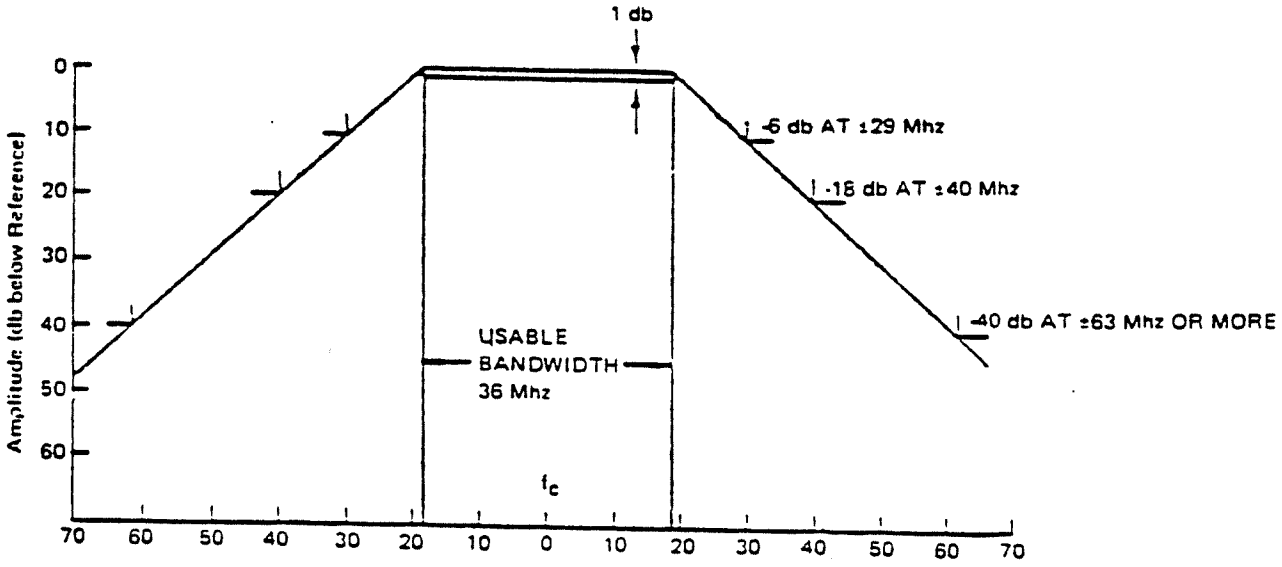


Figure 4 Specified Output Frequency Response

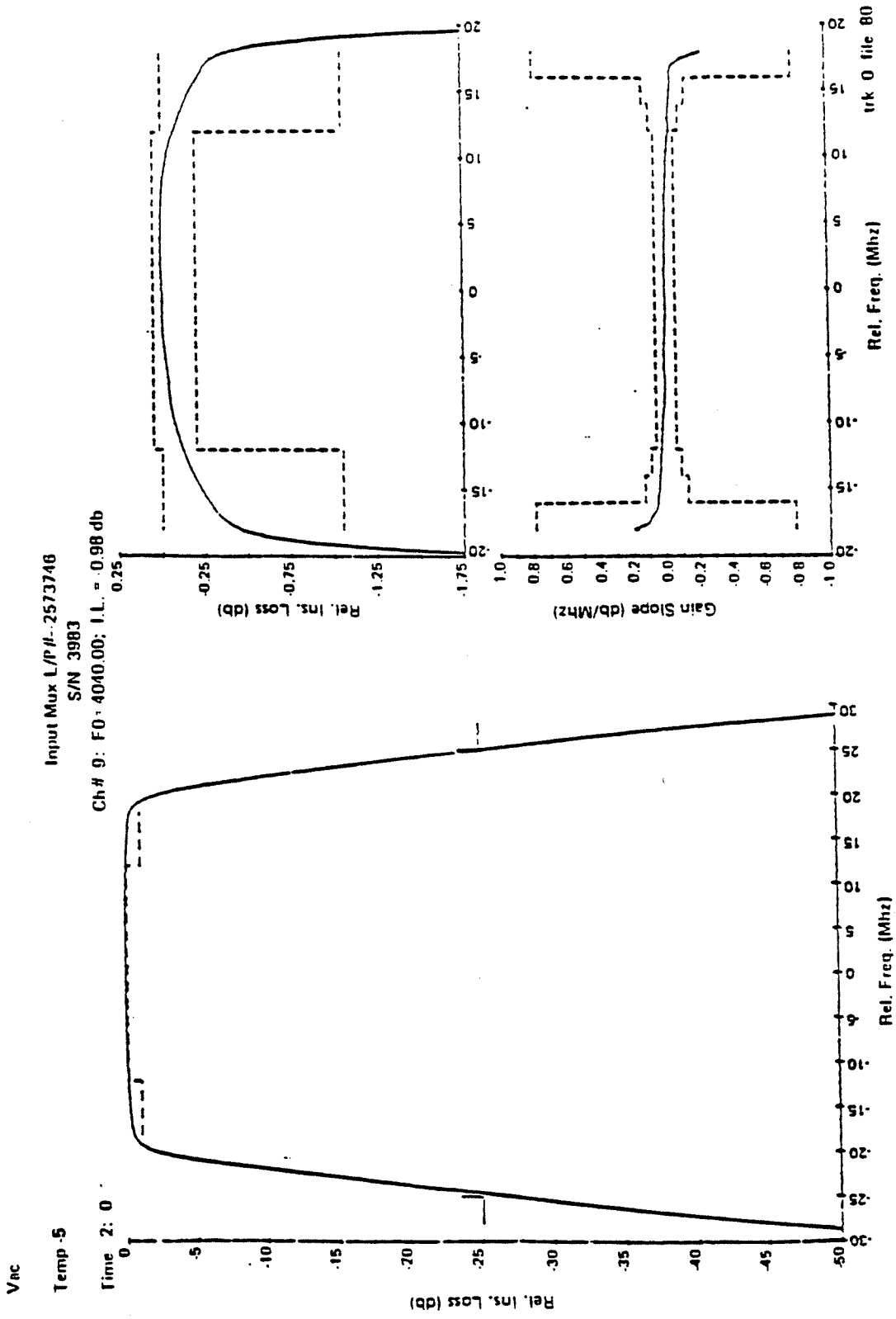


Figure 5 Typical Measured Input Frequency Response (Input Multiplexer Only)

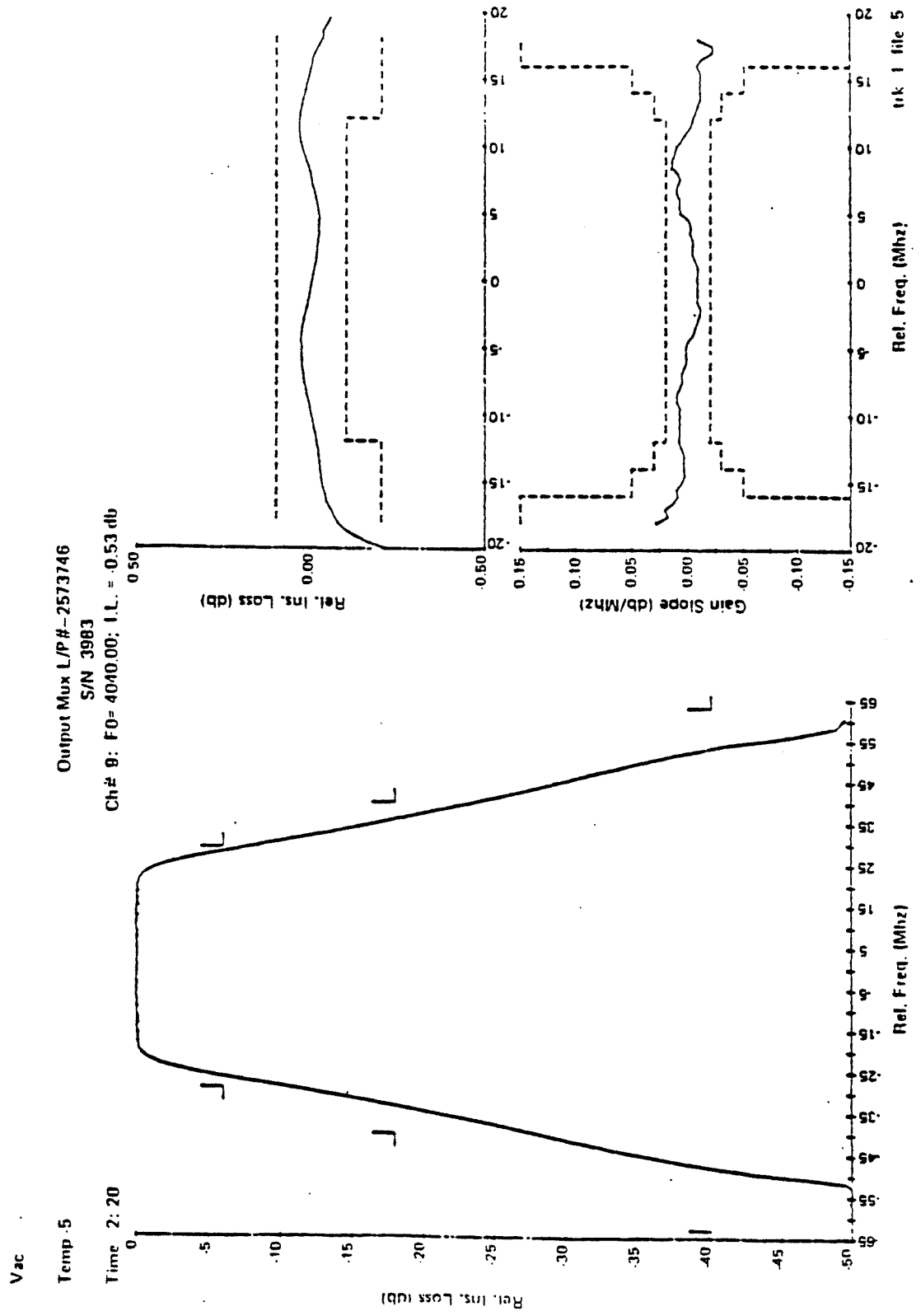


Figure 6 Typical Measured Output Frequency Response (Output Multiplexer Only)

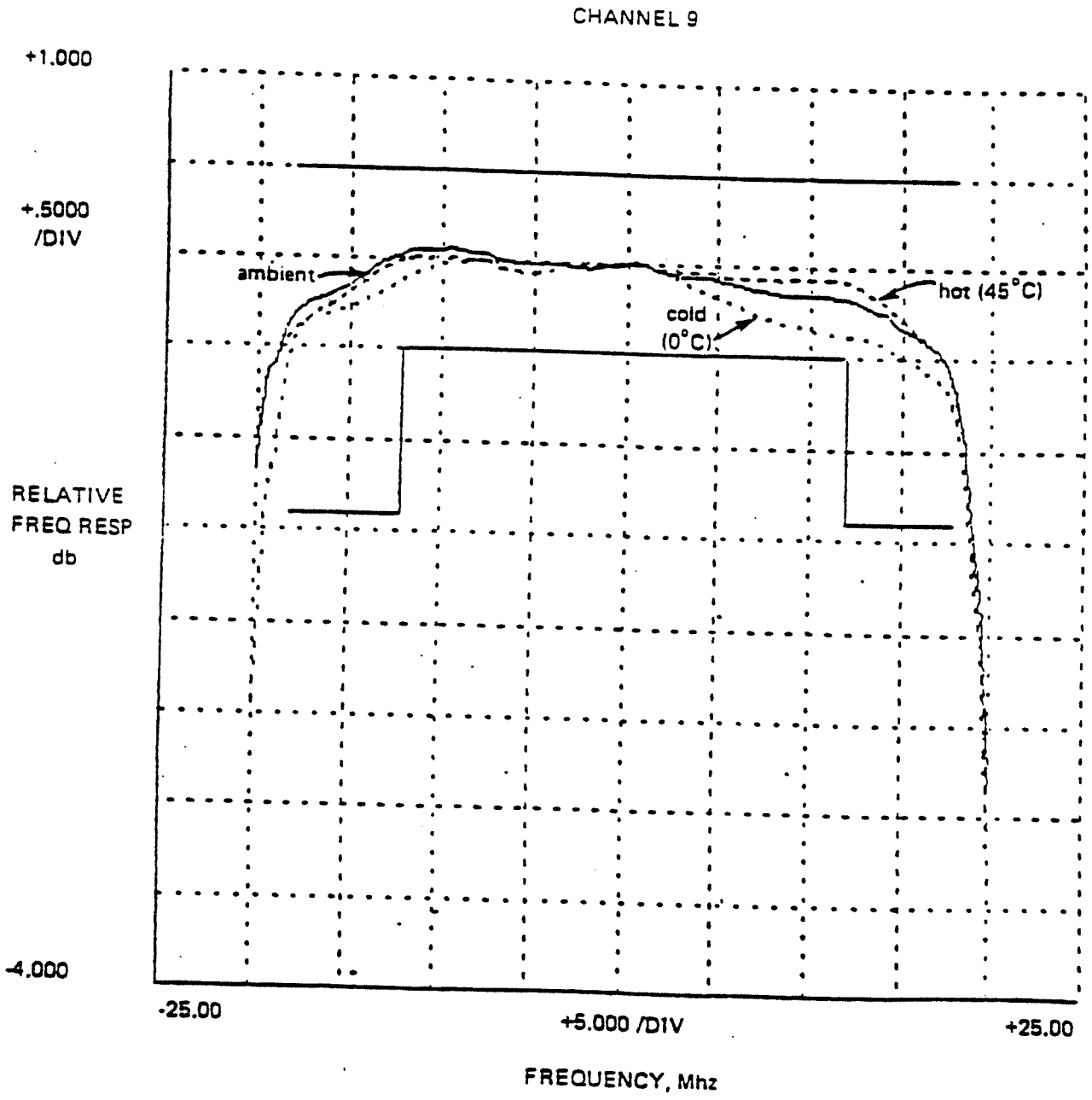


Figure 7 Typical Overall Channel Amplitude Response

The specific TT&C functions take place over transponders which operate over S-band and K-band frequencies assigned to U.S. Government use. These have already been approved by cognizant authorities.

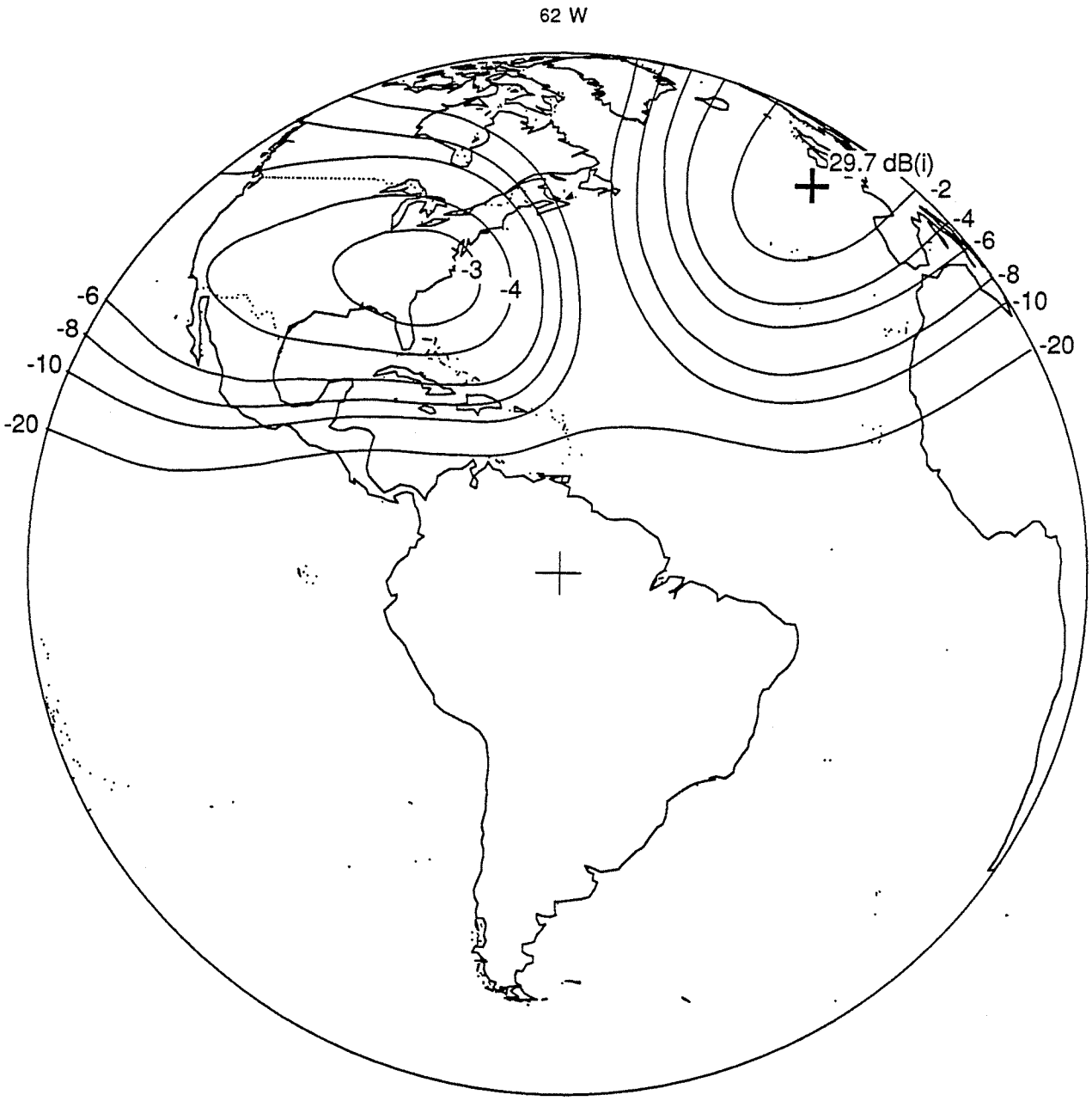
8. Space Station Coverage Contours

The expected coverage contours from the 62° W.L. location for the transmit and receive antenna are shown in Figures 8 and 9, providing coverage of the U.S. from single shaped uplink and downlink beams. These gain contours are overlaid on perspective maps of the world showing the coverage area for the satellite.

EIRP contours can be determined from the transmit antenna gain contours by adding 6.1 dBW to the gain contour values. Similarly G/T contours can be obtained by subtracting 33.1 dB/K from the receive gain contour values. The transponder saturation flux density can be obtained by subtracting the receive gain contour value from -53.8 dBW/m^2.

A functional block diagram of the satellite transponder is shown in Figure 10. The satellite employs 2 redundant C-band receivers, which may be selected and powered on or off by ground command. The receiving antenna pattern is formed by phasing network. The receivers convert the uplink 5925-6425 MHz signal to the downlink band 3700-4200 MHz. The signal is supplied via

10-A

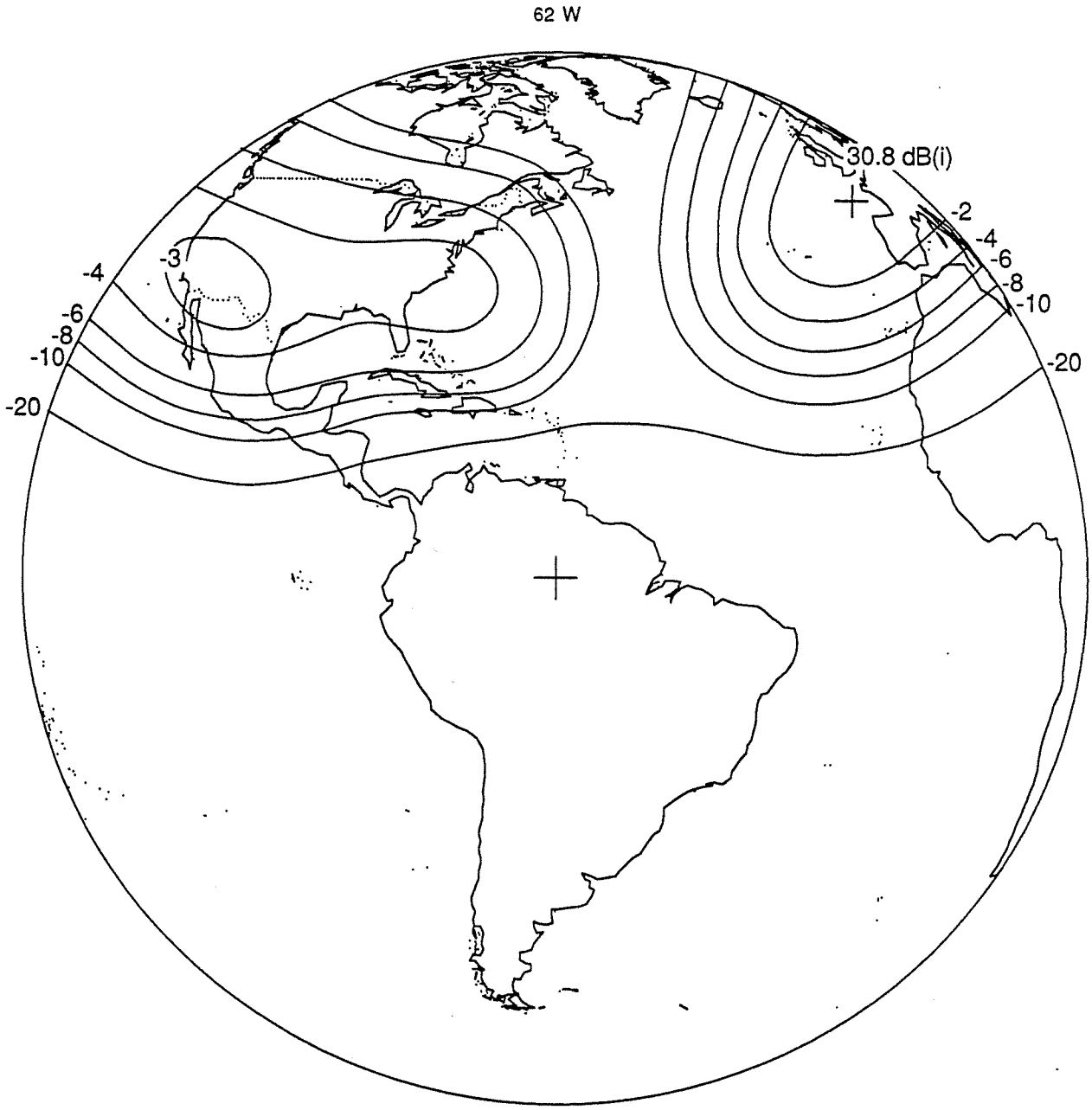


Transmit Gain Contours (62° W)

This Figure Includes Pointing Errors

Figure 8

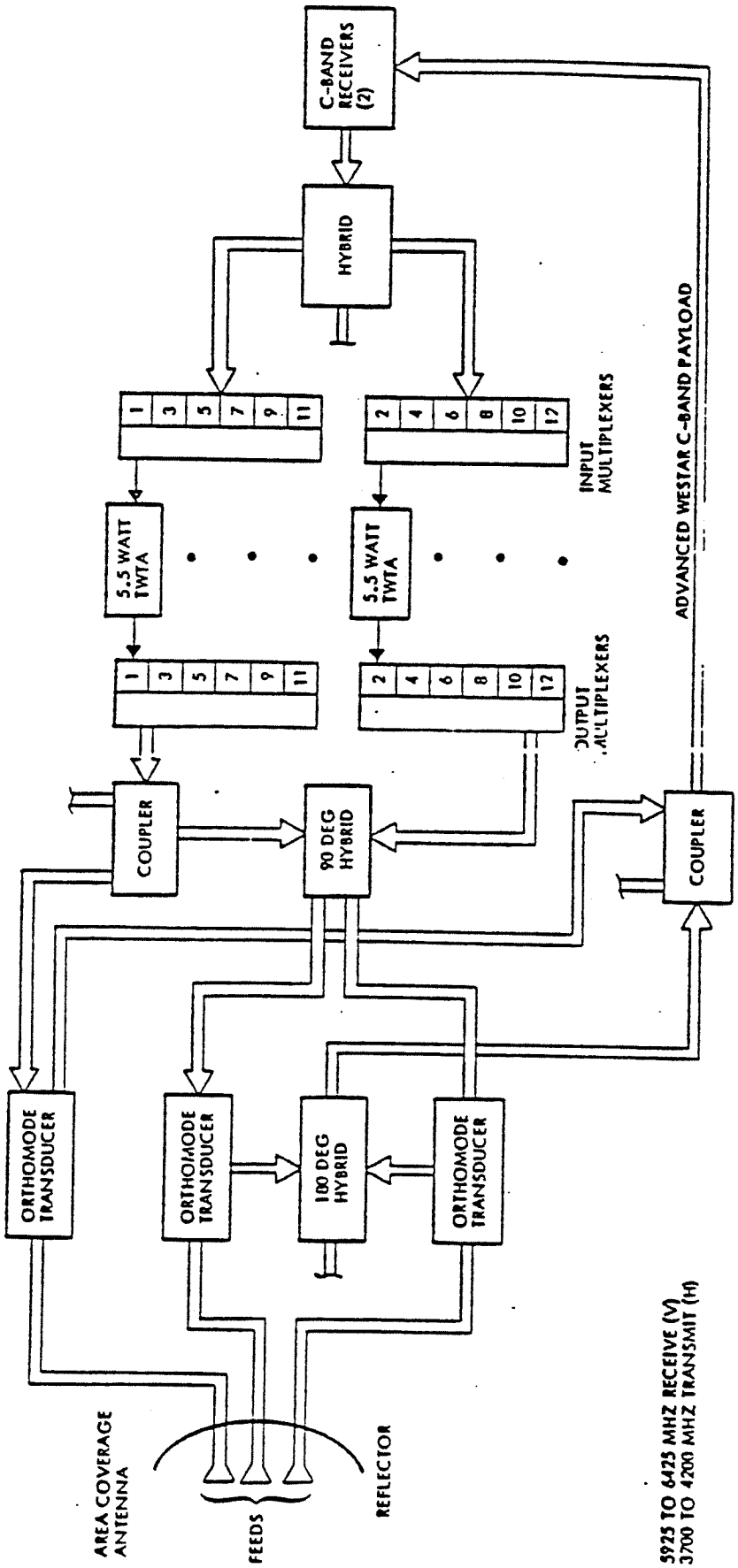
10-B



Receive Gain Contours (62° W)

This Figure Includes Pointing Errors

Figure 9



C-BAND COMMUNICATIONS PAYLOAD

Figure 10

a hybrid network to two banks of multiplexers, associated with odd and even channels. The separated 36 MHz channels are then each used to drive individual channel 5.5 W TWT amplifiers. Output of the amplifiers is then combined by use of output multiplexers and supplied to the two input ports of the antenna phasing system which in turn provides the signals to the antenna horns.

Separation of the orthogonally polarized signals for receiving and transmitting is achieved by means of orthomode couplers associated with each horn.

Each of the 12 C-band TWTAs may be commanded on or off from the ground facility at White Sands, New Mexico.

9. Physical Characteristics of the Space Station

The space station is a three axis stabilized communications satellite, which supports multiple communications functions. The overall configuration of the satellite is shown in Figure 1 (page 1-A). The satellite consists of a main body which contains power subsystem, tracking, telemetry and command, attitude control system, as well as communications modules. Mounted on the earth facing side of the main body are 30 helix antennas which support multiple access communications. Also located on the body is a K-band communications antenna. Two

large steerable single access antennas are located on booms extending from opposite sides of the spacecraft body. Perpendicular to this axis are booms supporting two solar arrays. On one of these booms is located the space-to-ground link antenna. The orientation of the C-band antenna is fixed with respect to the spacecraft. This antenna is designed to function in the commercial domestic satellite bands. The communication system which is the subject of this request will make use of this antenna and its associated transponders.

Figure 11 contains a view of the earth pointing face of the spacecraft in the deployed configuration, and gives the overall dimensions of the spacecraft; and in addition illustrates the pointing limits for the space-to-ground link antenna, and the two single access antennas.

A side view of the spacecraft is illustrated in Figure 12.

The satellite is intended to be launched by the Space Transportation System (STS) also known as the Space Shuttle in conjunction with the Boeing Inertial Upper Stage (IUS), which is capable of launching 5,000 pounds into geostationary orbit. The weight summary for the spacecraft is given in Table 3.

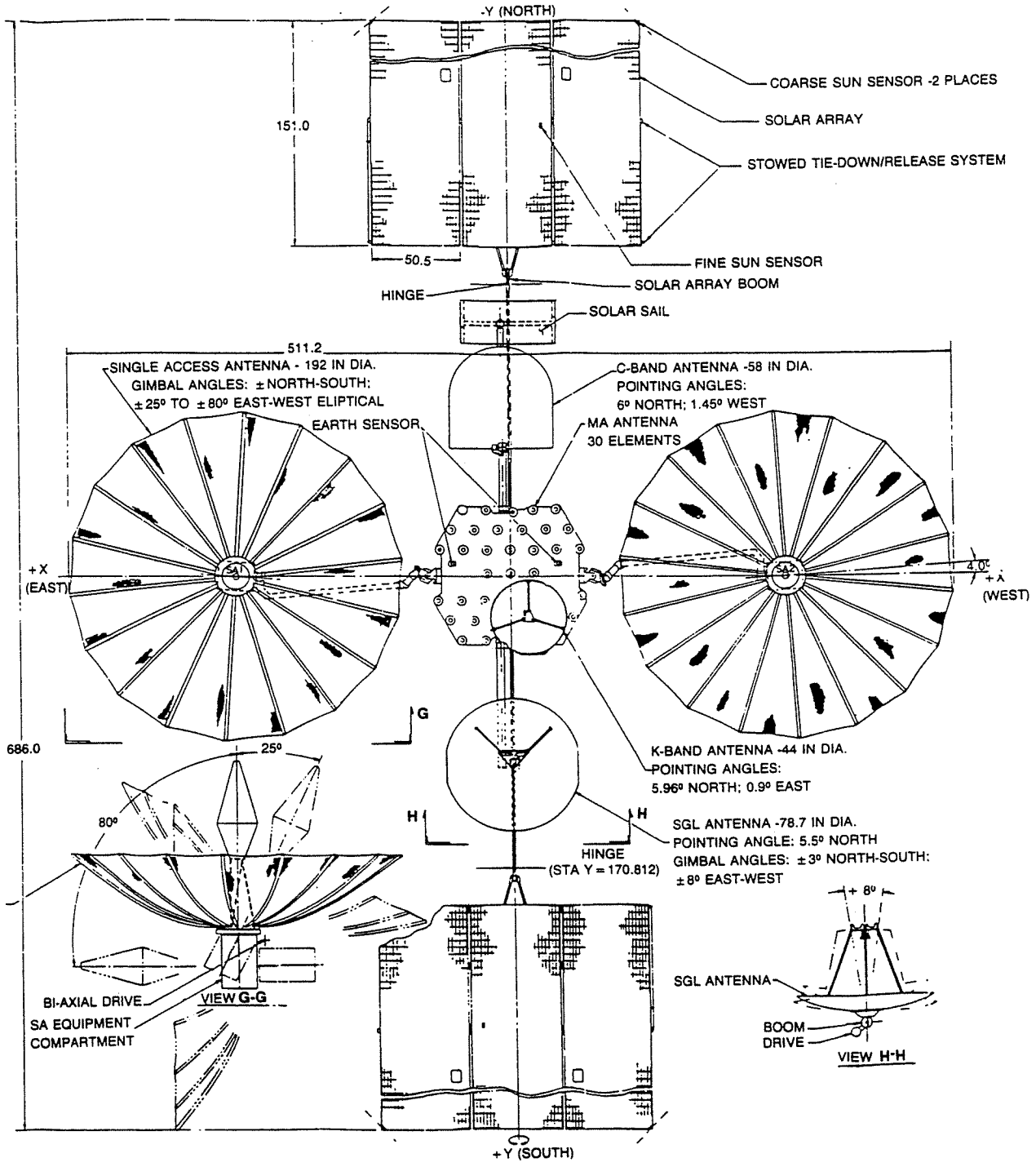


Figure 11 Deployed Spacecraft
Earth Pointing Face

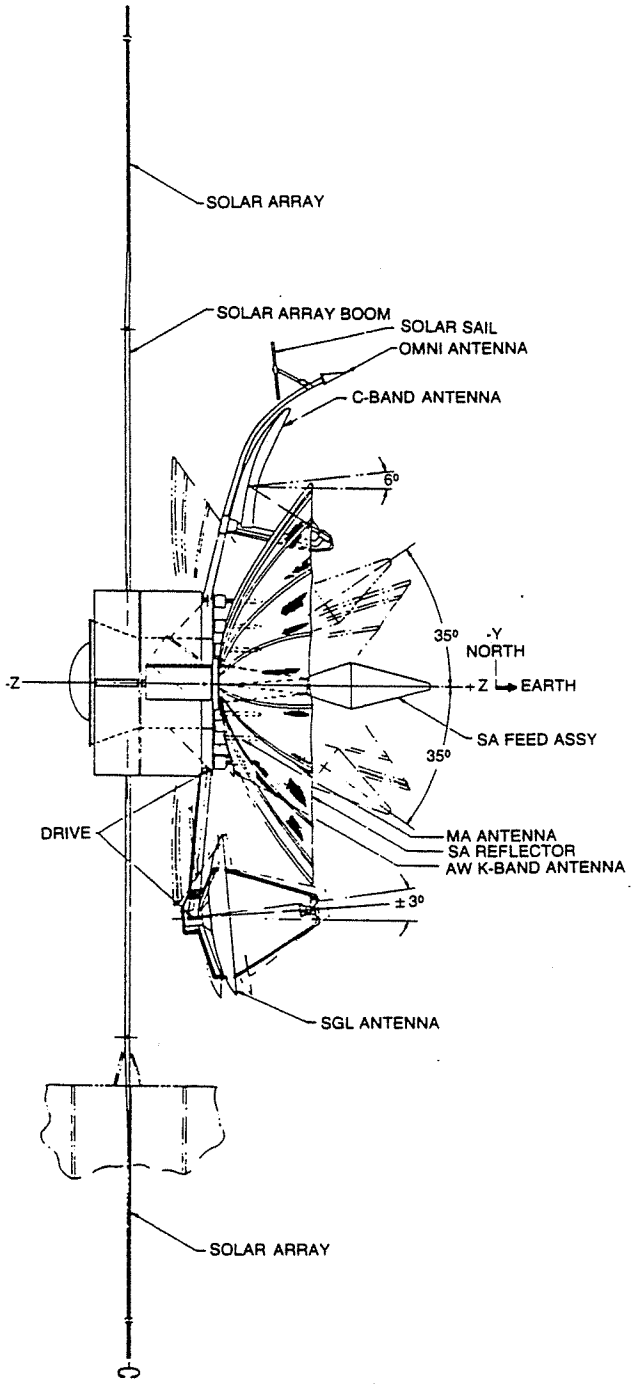


Figure 12 Spacecraft Display Configuration (Side View)

Table 3

WEIGHT SUMMARY

SUBSYSTEM	WEIGHT (POUNDS)
TELECOMMUNICATIONS - ELECTRONICS	651.4
- ANTENNAS	192.9
TT&C	107.5
ATTITUDE CONTROL	212.6
PROPULSION	190.8
ELECTRICAL POWER	912.4
THERMAL	95.0
STRUCTURES	976.0
SPACECRAFT DRY WEIGHT	3338.6
- CONTINGENCY/MARGIN	5.7
- PROPELLANT/PRESSURANT	1327.8
SPACECRAFT AT SEPARATION	4672.1
ADAPTER	265.9
IUS CHARGEABLE WEIGHTS	62.0
SPACECRAFT AT LAUNCH	5000.0

10. Orbit Parameter Accuracy and Antenna Pointing Accuracy

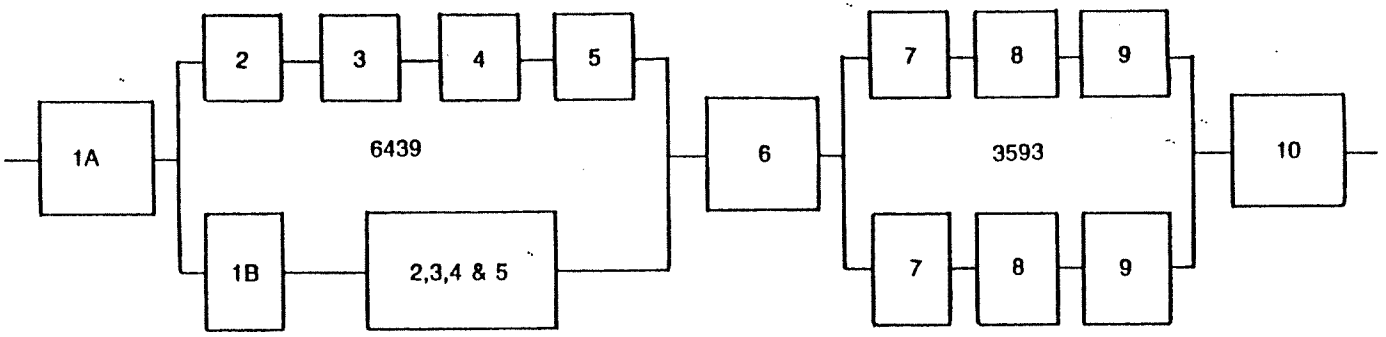
The TDRS spacecraft will be launched into a 0° inclination geostationary orbit. Stationkeeping maneuvers regulating orbital inclination and longitudinal drift will cause the satellite position to be maintained within a 0.1° by 0.1° N/S, E/W rectangle as required by Commission regulations applicable to domestic communications satellites.

The pointing error of the C-band antenna including the effects of combined spacecraft attitude and pointing errors, as well as errors in the alignment of the C-band antenna with respect to both the spacecraft body and other antenna is calculated to have a maximum 3 sigma radius of 0.3°.

11. Estimated Lifetime

The estimated lifetime of the satellite in orbit is 7 years. This expectation is based on rate of expenditure of the hydrazine propellant, and reliability considerations regarding the payload. It is expected that a useful portion of the payload will still be operational after 10 years in orbit.

Figure 13 shows a reliability block diagram for the C-band payload. Figure 14 is a graph showing the probability of survival of 10 of 12 transponders and 12 of 12 transponders as a

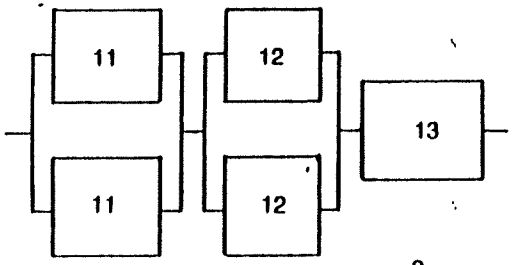


* (9,6439E-9,665E-9,0,0)

* (7,3593E-9,12,2,0) FOR 10 OF 12 SURVIVE
* (7,3593E-9,12,0,0) FOR 12 OF 12 SURVIVE

BLOCK	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13
DESCRIP-TION	BP INPUT FILTER, COAXIAL FERRITE SW	2X 2 FERRITE SWITCH DRIVERS	TDA	2 ISOL, LO ATTEN, MIXER	ATT, FILT	TRANS AMP	HYBRID, 4 ISOL 2 CIRC 4 MANIF 4 TRANS	COAX TO WG TRANS MUX FILT ISOL ATTEN	TWTA	OUTPUT FILT &COAX W/G TRANSITIONS	2 MANIFOLDS 2 ISOLATORS 2 L.P. FILT 2 HARM. FILT	POWER	COM-MAND	TELE-METRY
FAILURE RATE F/10^9 H	35.5	207	213	1619	92	4515	83	62.5	3500	30.5	148	504	1763	98
DUTY CYCLE	1	1	1	1	1	1	1	1	1	1	1	1	.03	1

(53)

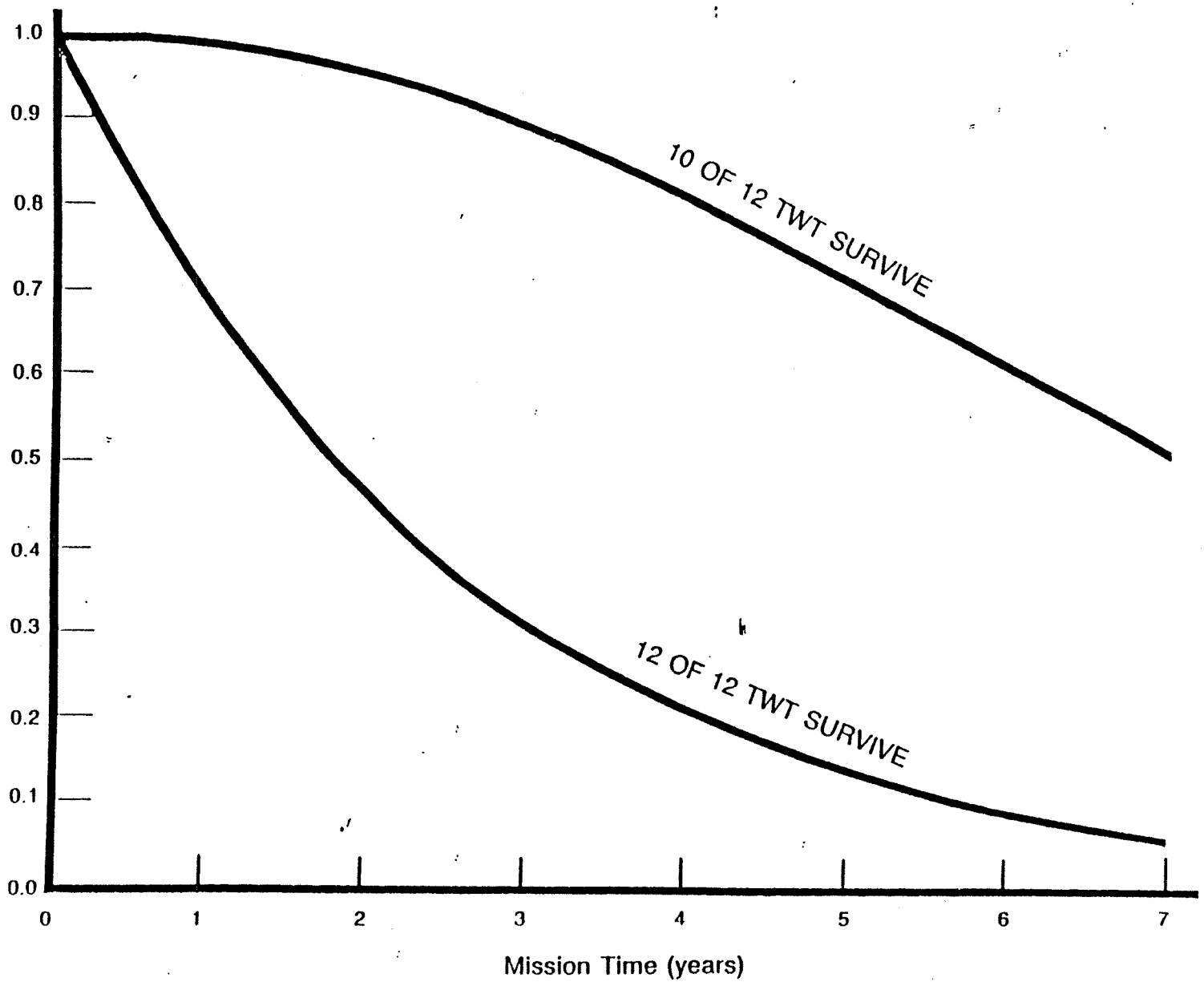


*(FUNCTION#, FAILURE RATE PER 10^9 HRS., STANDBY TO ACTIVE FAILURE RATE RATIO, FAILURE RATE OF SWITCHING CIRCUIT, REPLICATION FACTOR)

		TWTA SURVIVING (OF 12)	HOURS
$R_{(6\ months)}$	= 0.8262	12	4583
	0.9973	10	
$R_{(7\ years)}$	= 0.0648	12	61362
	0.5169	10	
		1 YR	8766

Figure 13

RELIABILITY BLOCK DIAGRAM FOR C-BAND TRANSPONDER (WITH POWER, COMMAND AND TELEMETRY)



C-BAND TRANSPONDER (WITH POWER, COMMAND AND TELEMETRY) SURVIVAL CURVES.

Figure 14

function of years in orbit.

12. Spacecraft Attitude Control Subsystem

The satellites are three axis stabilized. After being placed in synchronous orbit by the Interim Upper Stage (IUS) vehicle, and following separation from the IUS, the spacecraft attitude is maintained by a combination of earth sensors, gyros, inertia wheels and hydrazine thrusters coupled with ground generated commands as described below.

(a) Separation/Earth Acquisition

After arrival at synchronous orbit, the IUS orients the spacecraft to within 2° of on-orbit attitude. While attached to the IUS, the spacecraft solar arrays, space/ground link antenna, and C-band antenna are deployed. At IUS/spacecraft separation, a separation signal activates the spacecraft attitude control subsystem inertial hold mode and initializes the gyro reference. Control is then provided by three axis thruster firings in response to gyro attitude and rate signals. The inertial hold pointing error is less than 0.5° per axis. When the separation rates are damped, the earth mode for final earth acquisition is enabled by the ground station. During that time, the single access antennas are deployed and the reflectors released. In this mode, thruster

control the spacecraft in response to error signals from the earth sensor for pitch/roll and the gyro for yaw. The error signals are used to control the spacecraft in an attitude deadband equal to 0.15° for pitch and roll and 0.2° for yaw. The infrared earth sensor continuously scans across the earth to determine the angular position of the earth with respect to the sensor axis. The outputs are binary words representing pitch and roll error signals which are generated by each scan.

(b) Normal Mode

Once stabilized in earth mode the ground system will configure the spacecraft for the entry into normal mode operations as follows:

- o Run-up reaction wheels to operating speeds
- o Correct solar array pointing and enable solar array clocking
- o Enable normal mode
- o Disable earth mode and thrusters
- o Reconfigure electronics, turn off gyros

In this mode the spacecraft +Z (yaw) axis is pointed at earth nadir, the +X (roll) axis is aligned with the Velocity vector and the +Y (pitch) axis is perpendicular to the orbit plane.

Attitude control is maintained during normal mode by momentum exchange between on-board reaction wheels and the spacecraft body. Earth sensors measure pitch and roll attitude errors. These error signals are processed in the ASC Control Processor which provides wheel drive commands to the reaction wheel drive electronics which in turn controls wheel speed. It is the modulation of wheel speed that controls three-axis pointing of the spacecraft.

There are four reaction wheels, two of which remain unpowered and are intended for standby redundancy. Each wheel stores 20 ft.-lb-sec. of momentum along its axis at 3100 rpm. The spin axes of the active pair of reaction wheels are arranged in a "vee" configuration in the Y-Z plane with each wheel offset 25 degrees from the Y-axis. When the two active reaction wheels are spun at nominally equal speeds, the total momentum vector lies along the pitch axis (Y-axis), which produces a torque about the pitch axis while the yaw axis (z-axis) component of momentum is cancelled.

In the normal mode, the ACS will control attitude errors to within the following values:

Roll 0.15°

Pitch 0.15°

Yaw 1.0°

These pointing uncertainties are due to a combination of earth sensor errors and the dynamic response of the control loop. The earth sensor errors include noise, earth radiance errors (i.e., the maximum/minimum radiance level differences across the earth), bias errors due to environment effects and supply voltage variation errors. The earth sensor contributes approximately 50% to the total attitude error.

(c) Pitch Control

For pitch axis attitude control, the earth sensor pitch error signal is provided to the Control Processor where wheel drive commands are generated for the Wheel Drive Electronics. The wheel tachometer feedback is compared to the wheel drive command and the difference converted to a proportional voltage for the wheel motor. Both wheels are driven to the required equal speeds to produce the desired pitch axis control torques.

The solar torques about the pitch axis are primarily cyclic (at orbit rate) and cause little net change in wheel speed each day. (Slowing of the single access antenna in the east/west direction also causes a small variation in wheel speed during and following the maneuver. However, wheel speed returns to the value it had at the start of the maneuver.) The

small secular change from solar torques is unloaded by ground commanding single pitch axis thruster firings no more often than once every four days. The wheel will also be automatically unloaded when caged for a velocity change maneuver.

(d) Roll/Yaw Control

For roll axis control, the earth sensor roll error signal is provided to the control processor where commands are generated for the wheel drive electronics. In this case, however, wheel drive commands are generated that produce a differential wheel speed (k.e., one wheel speed increased, the other decreased) resulting in a constant pitch momentum and yaw component of momentum which controls roll pointing by inducing a processional torque about the roll axis. Yaw axis attitude control is provided passively by the pitch momentum bias producing a yaw stiffness (there is no active yaw attitude error sensing and control law).

This bias momentum approach meets roll/yaw pointing requirements with momentum unloadings no more frequently than once every 2 days.

The momentum dump sequence is ground commanded. The momentum stored along the yaw axis is proportional to the roll attitude error. The appropriate yaw thrusters are fired when

the roll error exceeds a threshold. This results in procession about the roll axis. These thrusters can be fired singularly or fired in couples to remove transverse momentum with minimum spacecraft translation. Orbit perturbations are, therefore, minimized.

The roll/yaw unloadings are performed by two yaw thruster firings separated by half a nutation period. In this way, these two pulses cause no nutation buildup except for the impulse variation between the two thrust segments. After the roll/yaw procession, the pitch wheel is unloaded (if necessary) as described above.

(e) Solar Array Control

The solar arrays are deployed prior to IUS/spacecraft separation. Prior to separation, the solar array is coarsely pointed towards the sun by ground initiated slewing commands which drive the arrays about the spacecraft pitch axis at the rate of 0.281° per second. Following separation, a more precise sun point is established. The ground then commands the ACS to automatically clock solar arrays at a rate of one revolution per day.

(f) Velocity Change Maneuvers

Velocity change maneuvers include initial orbit trim, repositioning and stationkeeping. In plane orbit trim is performed to (1) phase the orbit apogee/perigee with respect to the desired subpoint, and (2) trim the orbit period and circularize the orbit. The out-of-plane trim maneuver removes effects of any Shuttle/IUS inclination and ascending node errors. This places the satellite near the center of the longitude working deadband, with the inclination very near 0.1° and the ascending node in the region to maximize the time to the first stationkeeping maneuver. The working longitude deadband is $\pm 0.085°$.

An E/W - N/S stationkeeping cycle begins at the western edge of the working deadband with a slight decrease in orbital period due to satellite E/W thrusting. The resulting eastward drift rate causes the satellite to reach a point in 10 days where it would stop and begin to drift westward. At this point, a N/S maneuver is performed to reduce inclination (by as much as 0.1° in the nominal case). The radial velocity components from the N/S thrusters cause the satellite to shift eastward of the center of the longitude deadband. By sequencing each N/S maneuver into two equal segments, 12 hours apart, the diurnal motion due to the radial delta V components is eliminated by the equal and opposite delta Vs. However, the

eastward subpoint shift due to the eccentricity of the orbit between N/S delta V firing remains. This procedure maximizes the drift time available to reach either edge of the working longitude deadband in the event of E.W drift rate errors that couple from N.S delta V maneuvers. After the nominal N.S maneuver, the satellite will drift westward to the edge of the working deadband, completing the E/W and N.S cycle in approximately 30 days.

N/S stationkeeping maneuver execution errors couple into the orbit plane to cause E.W drift rate errors. The primary contributors are thruster mismatch, thrust misalignment and spacecraft attitude. Thruster pairs are selected to minimize mismatch based on the results of hot firing tests. Any mismatch that remains primarily is a bias error with a high degree of repeatability from firing to firing. Thruster misalignment is also primarily a bias error with a very high degree of repeatability. By reconstructing the first few N/W delta V maneuvers, any bias due to these two sources of error should be detectable.

Spacecraft yaw attitude error is the primary contributor to E/W drift rate error and is considered random. Yaw attitude is biased to zero for each maneuver.

During velocity maneuvers, three-axis on-board active attitude control is used, and control torques are generated by hydrazine thruster (plus and minus) on the same side of the spacecraft. Yaw attitude control is achieved by employing inversion logic which off-modulates the appropriate yaw thruster. Separate pitch and roll thrusters maintain attitude control for these axes. The reaction wheel is commanded into the speed cage mode after enabling the thruster control. The earth sensor provides pitch and roll error signals and the gyro provides yaw data. Ground command pulsing of roll, pitch, and yaw thrusters to augment the onboard closed loop control minimizes pointing errors resulting from yaw thruster induced disturbances. The disturbance torques are reasonably repeatable from one maneuver to the next although difficult to accurately estimate prior to launch. They are primarily due to yaw thruster misalignments, yaw thruster level mismatch, center of mass shift, and plume impingement on the SA antennas and solar arrays. The initial estimate of these torques and the required thruster firing rates will be obtained during the first orbital correction maneuver by observing the attitude offsets and thruster firings on telemetry. The results of previous thruster firings will be employed in subsequent velocity change maneuvers. Ground command pulsing of thrusters is employed only during the velocity change maneuvers.

(g) Backup Operation

The entire attitude control subsystem consists of cross-strapped redundant subassemblies. Single equipment failures can be accommodated by switching from a failed unit to the redundant unit. On-orbit, long term normal mode control relies upon only the reaction wheel control. In addition, the spacecraft is configured so that all sensor data are telemetered to the ground and spacecraft attitude can be controlled either by ground-commanded attitude bias or thruster-firing. The thruster command structure allows thrusters to be individually and independently ground commanded with firing time ranging from 50 milliseconds to full-on. All failure modes are benign and earth reacquisition can be achieved by ground commanding the ACS into the sun modes. In the sun mode, the coarse sun sensors are used for pitch and yaw error sensing and gyros are used for three-axis rate stabilization, including the capability for roll rate bias commands which will rotate the space at 0.25°/sec. The ground station will procedurally command the solar arrays to its zero position prior to entering the sun mode.

13. Electrical Energy System Description

The electrical power subsystem is an unregulated voltage-limited bus system adapted from the FLTSATCOM design. Prior to transfer orbit insertion the solar array is wrapped around the

spacecraft body and provides sufficient power to supply required loads and battery charge. While in transfer orbit, the array is deployed. On-orbit, sun tracking is achieved by the solar array drive assemblies. The solar panels contain separate lead and battery charge sections. A shunt limiter is connected across the solar array to limit the output voltage during those periods when the array capability exceeds the load requirements.

Eclipse and transient load power requirements are supplied by a battery system comprised of three nickel-cadmium batteries with individual cell protection electronics. The batteries will support the full telecommunications load through maximum eclipse. The power control unit (PCU) contain circuitry for control of the main bus, battery charge and discharge, and power distribution. All controls are commandable from the TDRSS installation at White Sands.

Protection against main bus failures is provided by physical separation of power conductors, the selection of their mechanical design to tolerate fault currents, and by fusing of all primary power distribution lines. Independent wiring and separate fuses connect redundant equipment to the main bus.

Secondary power is provided by spacecraft equipment converters, communications converters, and antenna compartment converters.

The converters have output over-voltage turn-off and over-current turn-off/current-limiting circuits so that they cannot be damaged in case of a connected load failure. Likewise, the connected load is not damaged by a converter malfunction. The redundant secondary loads are connected to a separate distribution bus. The distribution buses have a cross-strap switching capability allowing selection of either redundant converter section as the power source.

In prelaunch operations, the spacecraft will receive ground power to maintain the batteries in fully charged condition. During the initial ascent phase, spacecraft components will require the use of battery power. After firing jettison, the solar array, which is folded around the spacecraft, will supply the required power and begin recharging the batteries. In the transfer orbit, the spacecraft will be oriented so that its axis is greater than 30 but less than 60° to the sunline. For these sun angles the stowed array will provide a minimum power output of 230 watts and a maximum of 330 watts.

While in transfer orbit, while attached to the launch vehicle, the solar array is deployed and one wing is rotated 180°. For this configuration, the spin axis remains at 30 to 60° from the sunline, and the array provides 854 watts maximum. Selected loads are switched on to maintain the thermal environment.

After the spacecraft is in geosynchronous orbit, the telecommunications links are activated and the transfer orbit loads that are no longer required are switched off. The minimum solar array load capability in this mode after 10 years in orbit (end-of-life) is 1759 watts in summer solstice, well above the normal load requirement of 1621 watts.

14. Emission Limitations

The out of band emissions of the satellite transponder are limited by the frequency response of the input and output multiplexers. Typical characteristics of these multiplexers are given in Figures 5 and 6 (on pp.9-C and 9-D). The overall response is illustrated in Figure 7 (p.9-E) of this appendix. Inspection of these response curves will show that all spurious emissions from each transponder will be reduced to values well below those specified in the Commission's Rules, 47 C.F.R. § 25.202.

15. Implementation Plan

The development and construction of the spacecraft began in December 1976. It was completed in March 1984. The planned launch date and the estimated date by which the satellite will be placed into service are January, 1991 and April, 1991,

respectively.

16. Market And System Plan

(a) Types of Services.

The services provided will be those required by NASA. The services will take the form of digital data traffic between 56 kbps and 50 Mbps, TV signals and voice traffic. These services will be provided between points in the United States. The modulations used to provide these services will be TV-FM, wideband digital, SCPC-PSK and SCPM-FM. The overall link performance objectives for the services provided are given in Table 4.

Table 4

Overall Link Performance Objectives

Service	Objective
TV-FM	55 db p-p signal to weighted rms noise ratio
SCPC-FM	50 dB test tone to weighted rm noise ratio
SCPC-PSK	10-6 BER (S/N = 12 dB)

In the case of the voice channels, the noise objectives are divided pursuant to CCIR Recommendation 353-2 as follows:

Ground station equipment:	1000 pWOp
Ground station interference:	500 pWOp
Satellite interference:	1000 pWOp
Satellite noise:	7500 pWOp

Table 5 provides the link power budgets for all four types of services.

Table 5

Link Power Budgets

	TV-FM	Digital	SCPC/PSK	SCPC/FM
Downlink				
Bandwidth (MHz)	36.0	29.0	0.1	0.05
Earth Station Power (dBW)	26.0	27.0	-7.0	-6.0
Earth Station Gain (dBi)	54.0	54.0	54.0	54.0
Free Space Loss (dB)[1]	-199.6	-199.6	-199.6	-199.6
Atmospheric Loss	-0.2	-0.2	0.2	-0.2
Pointing Loss (dB)	-0.3	-0.3	-0.3	-0.3
Receive Antenna Gain (dBi)	27.3	27.3	27.3	27.3
Receive Power (dBW)	92.8	-91.8	-125.8	-124.8
KTB[2] (dBW)	-120.6	-121.5	-146.2	-149.2
C/N uplink (dB)	27.8	29.7	20.4	24.4

[1] Free Space Loss for an Earth Station Elevation of 10°.

[2] Satellite Receive Noise Temperative 1750° K.

Table 5 (continued)

Link Power Budgets

	TV-FM	Digital	SCPC/PSK	SCPC/FM
Downlink				
Satellite EIRP (dBW)[1]	34.4	35.4	1.4[1]	2.4[1]
Free Space Loss (dB)[2]	-196.1	-196.1	-196.1	-196.1
Atmospheric Loss (dB)	-0.1	-0.1	-0.1	-0.1
Pointing Loss	-0.2	-0.2	-0.2	-0.2
Earth Station Gain (dBi)	50.7	50.7	50.7	50.7
Received Power (dBW)	-111.3	-110.3	-144.3	-143.3
KTB[3]	-132.1	-133.0	-157.6	-160.6
C/N downlink (dB)	20.8	22.7	13.3	17.3
Total C/N	20.0	21.9	12.5	16.6
#Channels/Transponder	1	1	128	312

1 The SCPC EIRP's take into account the transponder backoff required to provide tolerable intermodulation degradation; additionally the small number of channels per transponder allows spacing of the carrier to further reduce intermodulation products.

2 Free Space Loss for Earth Station Elevation of 10°.

3 Earth Station Temperature 125° K.

(b) Link Availability.

Since the number and location of earth stations is indeterminate (see p. 3 of this Appendix), those aspects of system reliability, redundancy, and link availability peculiar to earth stations (including solar outages) will be addressed on a case-by-case basis.

17. Interference Analysis, 2° Spacing

(a) Introduction

An interference analysis was performed in order to assess the interference potential between the TDRSS C-band satellites and other authorized space stations. The analysis was performed using a spacing of 2° from each of the currently authorized space stations. The analysis presented here is based upon the assumptions, techniques, computer program, and system characteristics contained in the FCC report "Reduced Domestic Satellite Orbital Spacings at 4/6 GHz" (OST Report, FCC/OST R83-2, May 1983) and uses data available from the Commission regarding satellite characteristics for currently authorized space stations.

The following sections describe the systems characteristics, the interference model and the interference analysis performed.

(b) TDRSS C-band Signal Formats and Characteristics

The signal formats to be used by the TDRS-5 C-band satellite system are similar to those used by other currently authorized systems and are described in Table 6. The signal formats and characteristics used for all other satellites are from data available from the Commission and are presented in tabular form.

(c) Interference Model

The interference model used to analyze the potential for interference between satellites is the Adjacent Satellite Interference Program described in OST Report FCC/OST R833-2. This report describes, in detail, the interference computation formulae used and the theoretical basis behind the computer model. In addition to the standard, conservative assumptions implicit in the model, the following additional assumptions were made:

- The spectrum used for TV/FM signals is a 1.2 MHz energy dispersal spectrum.

- SCPC and small FDMA carriers have transponder frequency plans which avoid frequencies within ±1.5 MHz of the transponder center frequency.

- Earth station antenna radiation pattern follow a 29 - 25 log X curve, where X is the geocentric angle between satellites, in degrees.

- A maximum off-axis cross-polarization isolation in the earth station of 10 dB.

Table 6

Model Signal Formats and Signal Characteristics

Modulation Type	TV/FM	Digital	SCPC/PSK	SCPC/FM
RF Bandwidth (MHz)	36.0	29.0	.100	.050
Number of Channels	1	1	128	312
Code Rate/Mod. Index	2.619	---	---	12.0
Bottom Mod. freq. (MHz)	.020	---	---	000
Top Mod. Freq. (MHz)	4.200	---	---	.004
Average Talker Level (dBMO)	---	---	---	---
Compander Preemphasis				
Noise Weighting (dB)	12.8	---	---	17.4
Phases	---	4	2	---
Data Rate (Mbps)	---	50.0	.056	---
Channel Spacing	---	---	.200	.100
Transponder Frequency (GHz)				
Up	6.145	6.145	6.145	6.145
Down	3.920	3.920	3.920	3.920
Polarization - Up	Vert.	Vert.	Vert.	Vert.
Polarization - Down	Horz.	Horz.	Horz.	Horz.
Earth Station Transmitter				
Power (dBW)	26.0	27.0	-7	-6
Diameter (m)	10	10	10	10
Gain (dBi)	54.0	51	54	54
Satellite Receiver				
Gain (dBi)	27.3	27.3	27.3	27.3
Temperature (°K)	1750	1750	1750	1750
Satellite Transmit				
EIRP (dBW)	34.4	35.4	1.4	2.4
Earth Station Receiver				
Diameter (m)	10	10	10	10
Gain (dBi)	50.7	50.7	50.7	50.7
Temperature (°zk)	125	125	125	125

* Avoids ±1.5 MHz at transponder center.

The method by which the model calculates its results is to assume that each of the satellite carrier types is carried by a satellite located 2° away from each other carrier type. Given this situation, the carrier-to-interference ratio (C/I) is calculated for the carrier and used to determine the interference level in the receiver. The interference level is then

compared to the appropriate interference criteria for the victim receiver to determine whether the interfering signal meets the criteria. If the criteria are not met, the ratio is calculated, in dB, of the interfering signal to the interference criteria. This process is carried out for each potential interferor-victim pair.

(d) Interference Analysis

The interference model of the previous section, when applied in conjunction with the TDRSS C-band satellite characteristics given, produces the results contained in Tables 7 through 10. Table 7 contains the input parameters used in the model, including the TDRSS C-band characteristics (lines 61-64), and the characteristics of all other space stations (lines 1-60). Table 8 summarizes the thermal noise characteristics of each carrier. Table 9 summarizes the input assumptions made and contains footnotes applicable to the preceding tables. Table 10 summarizes the interference interactions between each pair of carriers. Since there are 64 carriers, there are 4096 possible interactions. The table details the number of dB by which an interfering signal exceeds the interference criteria of the desired signal. A blank entry for any interaction indicates that the interference criteria are met. An asterisk, "*", indicates that the interference exceeds the criteria by more than 9.5 dB. As can be seen in Table 10, TDRSS C-band is a

relatively low interference satellite system. This is due to an RF system and signal design that is highly compatible with existing satellites. Those systems having the most interference entries include satellites that are co-polarized with the TDRSS C-band system. As stated in OST Report FCC/OST R83-2, polarization interleaving between satellites is a necessary practice to achieving 2° satellite spacings.

CARRIER	COMPANY	TYPE	RF BAND-WIDTH (MHZ)	NO. OF CHAN	CODE RATE/ MOD. INDEX	BOT MOD. FREQ. (MHZ)	TOP MOD. FREQ. (MHZ)	AVE. TALKER LEVEL (DBM0)	CPAND PREMP NOISE WEIGH (DB)	PHASE	DATA RATE (MBPS)	CHAN. SPACE (MHZ)	TRANSPONDER FREQUENCY UP (GHZ)	TRANSPONDER FREQUENCY DN (GHZ)	POL UP	POL DN	EARTH STATION TRANSMITTER POWR (DBW)	EARTH STATION TRANSMITTER DIAM (M)	EARTH STATION TRANSMITTER GAIN (DB)	--SATELLITE-- RECEIVER GAIN (DB)	--SATELLITE-- RECEIVER TEMP (K)	--SATELLITE-- XMTR EIRP (DBW)	-EARTH STATION RECEIVER DIAM (M)	-EARTH STATION RECEIVER GAIN (DB)	-EARTH STATION RECEIVER TEMP (K)
1	ALAS	4	0.029	800	2.824	0.000	0.003	0.0	16.8	0	0.000	0.045	6.145	3.920	0	1	-8.2	15.0	57.8	28.2	750.	7.2	5.0	44.5	120
2	ASC	0	35.000	1800	0.388	0.060	7.860	-15.0	-10.3	0	0.000	0.000	6.145	3.920	0	1	25.0	13.0	56.0	25.0	800.	34.0	13.0	52.0	80
3	ASC	0	12.000	372	0.908	0.012	1.550	-20.0	0.0	0	0.000	12.000	6.145	3.920	0	1	10.7	10.0	53.5	25.0	800.	22.0	10.0	50.5	56
4	ASC	1	32.000	1	2.560	0.025	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	0	1	27.5	10.0	53.5	25.0	800.	34.0	5.0	44.5	125
5	ASC	2	36.000	1	0.000	0.000	0.000	0.0	0.0	4	64.000	0.000	6.145	3.920	0	1	24.5	10.0	53.5	25.0	800.	33.0	11.0	51.5	71
6	ASC	2	9.600	1	0.000	0.000	0.000	0.0	0.0	4	7.700	0.000	6.145	3.920	0	1	24.5	10.0	53.5	25.0	800.	33.0	3.0	39.5	130
7	ASC	2	3.750	8	0.000	0.000	0.000	0.0	0.0	4	4.000	4.000	6.145	3.920	0	1	11.5	10.0	53.5	25.0	800.	23.0	10.0	50.5	89
8	ASC	2	1.100	32	0.000	0.000	0.000	0.0	0.0	4	1.544	1.300*	6.145	3.920	0	1	3.1	10.0	53.5	25.0	800.	14.1	10.0	50.5	56
9	ASC	3	0.040	160	0.000	0.000	0.000	0.0	0.0	4	0.056	0.200*	6.145	3.920	0	1	1.1	5.0	47.3	25.0	800.	7.5	5.0	44.5	125
10	ASC	3	0.040	620	0.000	0.000	0.000	0.0	0.0	4	0.056	0.048*	6.145	3.920	0	1	-9.5	10.0	53.5	25.0	800.	1.0	10.0	50.5	89
11	AT&T	5	34.000	7800	0.000	1.000	17.000	-22.0	0.0	0	0.000	0.000	6.145	3.920	1	1	19.4	30.0	62.3	24.5	900.	28.6	30.0	59.3	54
12	AT&T	5	30.000	6000	0.000	1.000	15.000	-22.0	0.0	0	0.000	0.000	6.145	3.920	1	1	27.6	12.0	55.1	24.5	900.	29.8	12.0	52.5	71
13	AT&T	0+	36.000	1800	0.351	0.564	8.524	-20.0	0.0	0	0.000	0.000	6.145	3.920	1	1	28.3	30.0	62.3	24.5	900.	35.0	30.0	59.3	54
14	AT&T	1	36.000	1	2.571	0.025	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	1	1	27.5	10.0	53.5	24.5	900.	35.0	7.0	47.5	125
15	AT&T	2	36.000	1	0.000	0.000	0.000	0.0	0.0	4	60.000	0.000	6.145	3.920	1	1	27.0	12.0	55.1	24.5	900.	34.2	12.0	52.5	71
16	AT&T	2	36.000	1	0.000	0.000	0.000	0.0	0.0	8	90.000	0.000	6.145	3.920	1	1	21.6	30.0	62.3	24.5	900.	33.0	30.0	59.3	54
17	AT&T	2	1.060	24	0.000	0.000	0.000	0.0	0.0	4	1.544	1.300*	6.145	3.920	1	1	13.1	10.0	53.5	24.5	900.	15.7	10.0	50.5	71
18	AT&T	2	1.853	5	0.000	0.000	0.000	0.0	0.0	4	1.544	5.000	6.145	3.920	1	1	13.5	10.0	53.5	24.5	900.	24.0	3.0	39.5	130
19	RCA	5	34.000	5820	0.000	1.000	17.000	-21.0	7.8	0	0.000	0.000	6.145	3.920	0	1	18.0	13.0	56.0	24.0	750.	30.0	13.0	53.0	80
20	RCA	0	36.000	2892	0.323	0.012	12.388	-18.0	-11.1	0	0.000	0.000	6.145	3.920	0	1	25.0	13.0	56.0	24.0	750.	34.0	13.0	52.0	80
21	RCA	0	36.000	1932	0.385	0.012	8.120	-15.0	-10.3	0	0.000	0.000	6.145	3.920	0	1	25.0	13.0	56.0	24.0	750.	34.0	13.0	52.0	80
22	RCA	0	20.700	432	1.501	0.012	1.796	-15.0	0.0	0	0.000	18.000	6.145	3.920	0	1	13.9	13.0	56.0	24.0	750.	25.5	13.0	52.0	80
23	RCA	1	36.000	1	2.560	0.025	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	0	1	25.0	13.0	56.0	24.0	750.	34.0	13.0	52.0	80
24	RCA	1	36.000	1	2.560	0.025	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	0	1	26.7	11.0	54.3	24.0	750.	34.0	11.0	51.3	80
25	RCA	1	18.000	1	1.500	0.025	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	0	1	22.7	11.0	54.3	24.0	750.	33.0	7.0	47.5	80
26	RCA	2	36.000	1	0.000	0.000	0.000	0.0	0.0	4	60.000	0.000	6.145	3.920	0	1	26.7	11.0	54.3	24.0	750.	34.0	11.0	51.3	107
27	RCA	2	16.600	1	0.000	0.000	0.000	0.0	0.0	2	8.800	0.000	6.145	3.920	0	1	22.5	13.0	56.0	24.0	750.	34.0	3.1	39.5	130
28	RCA	2	1.030	32	0.000	0.000	0.000	0.0	0.0	4	1.544	1.300*	6.145	3.920	0	1	7.9	11.0	54.3	24.0	750.	15.0	11.0	51.3	107
29	RCA	3	0.064	100	0.000	0.000	0.000	0.0	0.0	2	0.064	0.280*	6.145	3.920	0	1	7.6	5.0	47.4	24.0	750.	9.0	5.0	44.5	125
30	RCA	4	0.037	620	4.412	0.000	0.003	0.0	25.8	0	0.000	0.048*	6.145	3.920	0	1	-1.0	10.0	53.5	24.0	750.	0.0	10.0	50.5	112
31	RCA	6	0.450	80	0.000	0.000	0.000	0.0	13.7	2	0.010	0.450	6.145	3.920	0	1	19.8	1.4	36.2	24.0	750.	10.0	1.4	32.8	120
32	W.U.	0	36.000	1500	0.527	0.060	6.748	-15.0	0.0	0	0.000	0.000	6.145	3.920	1	0	23.2	15.0	57.8	25.0	800.	34.0	15.0	54.7	54
33	W.U.	0	4.500	60	2.053	0.060	0.300	-15.0	0.0	0	0.000	5.000	6.145	3.920	1	0	2.2	15.0	57.8	25.0	800.	18.0	15.0	54.7	54
34	W.U.	1	36.000	1	2.619	0.025	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	1	0	25.1	11.0	54.3	25.0	800.	34.0	11.0	51.3	54
35	W.U.	2	36.000	1	0.000	0.000	0.000	0.0	0.0	4	62.000	0.000	6.145	3.920	1	0	20.2	15.0	57.8	25.0	800.	33.0	15.0	54.7	54
36	NPR	4	0.180	21	5.000	0.000	0.015	0.0	29.0	0	0.000	PLAN	6.145	3.920	1	0	12.0	4.6	46.5	25.0	800.	16.5	4.6	43.5	125
37	MUZK	4	0.120	7	3.000	0.000	0.015	0.0	29.0	0	0.000	PLAN	6.145	3.920	1	0	10.7	10.0	53.5	25.0	800.	22.0	1.2	31.5	230
38	A.P.	3	0.038	56	0.000	0.000	0.000	0.0	0.0	4	0.056	0.500*	6.145	3.920	1	0	-0.5	10.0	53.5	25.0	800.	12.0	3.0	39.5	148
39	A.P.	3	0.174	6	0.000	0.000	0.000	0.0	0.0	4	0.256	5.000*	6.145	3.920	1	0	6.5	10.0	53.5	25.0	800.	18.6	3.0	39.5	148
40	MBS	4	0.200	6	5.667	0.000	0.015	0.0	29.0	0	0.000	PLAN	6.145	3.920	1	0	6.7	11.0	54.3	25.0	800.	19.0	1.8	34.5	148
41	EQU	6	4.915	6	0.000	0.000	0.000	0.0	24.1	2	0.010	6.000	6.145	3.920	1	0	4.8	18.3	58.2	25.0	800.	20.0	0.6	26.0	120
42	HUGH	0	36.000	960	1.097	0.060	4.028	-15.0	0.0	0	0.000	0.000	6.145	3.920	1	0	27.0	10.0	54.0	24.8	800.	34.0	10.0	50.7	125
43	HUGH	1	36.000	1	2.619	0.020	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	1	0	27.0	10.0	54.0	24.8	800.	34.0	4.5	44.0	125
44	HUGH	2	4.000	4	0.000	0.000	0.000	0.0	0.0	4	6.400	8.000	6.145	3.920	1	0	11.0	10.0	54.0	24.8	800.	24.0	10.0	50.7	125
45	HUGH	4	0.020	398	5.600	0.000	0.003	0.0	23.5	0	0.000	0.080*	6.145	3.920	1	0	-2.5	4.5	47.1	24.8	800.	3.7	4.5	44.0	125
46	SPC	0	36.000	1872	0.407	0.012	7.868	-15.0	-10.3	0	0.000	0.000	6.145	3.920	1	0	27.0	10.0	54.0	26.0	750.	34.0	10.0	50.5	112
47	SPC	0	17.500	432	1.019	0.564	2.074	-15.0	0.0	0	0.000	18.000	6.145	3.920	1	0	19.0	10.0	54.0	26.0	750.	30.0	10.0	50.5	112
48	SPCW	0	36.000	1872	0.407	0.012	7.868	-15.0	-10.3	0	0.000	40.000	6.145	3.920	0	1	15.2	13.0	56.3	26.0	750.	32.0	13.0	52.0	80
49	SPCW	1	36.000	2	2.690	0.025	4.200	0.0	13.0	0	0.000	40.000	6.145	3.920	0	1	17.5	10.0	54.0	26.0	750.	32.0	7.0	47.5	120
50	SPCW	2	72.000	1	0.000	0.000	0.000	0.0	0.0	4	125.000	0.000	6.145	3.920	0	1	24.0	10.0	54.0	26.0	750.	35.7	10.0	50.5	112
51	PAN	1	26.400	1	2.143	0.020	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	1	0	29.4	5.0	47.3	23.2	800.	38.7	5.0	43.8	125
52	PAN	0	36.000	972	1.104	0.012	4.028	-15.0	0.0	0	0.000	0.000	6.145	3.920	1	0	27.6	10.0	53.4	23.2	800.	34.0	10.0	49.8	95
53	PAN	0	4.500	72	2.053	0.012	0.300	-15.0	0.0	0	0.000	5.000	6.145	3.920	1	0	8.9	10.0	53.4	23.2	800.	25.3	10.0	49.8	95
54	PAN	3	0.056	500	0.000	0.000	0.000	0.0	0.0	4	0.064	0.067*	6.145	3.920	1	0	-3.6	5.0	47.3	23.2	800.	7.4	5.0	43.9	110
55	FINS	6	3.600	10	0.000	0.000	0.000	0.0	21.1	2	0.019	3.600	6.145	3.920	0	1	10.0	10.0	53.5	29.0	800.	25.6	0.6	26.0	200
56	FINS	6	3.600	10	0.000	0.000	0.000	0.0	21.1	2	0.019	3.600	6.145	3.920	0	1	10.0	10.0	53.5	29.0	800.	25.6	1.8	33.2	200
57	FINS	6	3.600	10	0.000	0.000	0.000	0.0	12.4	2	0.144	3.600	6.145	3.920	0	1	19.8	1.8	37.3	29.0	800.	25.6	10.0	50.7	120
58	FINS	6	3.600	10	0.000	0.000	0.000	0.0	33.3	2	0.001	3.600	6.145	3.920	0	1	-1.0	10.0	53.5	29.0	800.	4.8	10.0	50.7	120
59	FINS	2	1.030	32	0.000	0.000	0.000	0.0	0.0	4	1.544	1.300*	6.145	3.920	0	1	4.5	10.0	54.0	29.0	800.	19.5	10.0	50.7	120
60	FINS	2	36.000	1	0.000	0.000	0.000	0.0	0.0	4	60.000	0.000	6.145	3.920	0	1	24.0	10.0	54.0	29.0	800.	37.6	10.0	50.7	120
61	TDRS	1	36.000	1	2.619	0.020	4.200	0.0	12.8	0	0.000	0.000	6.145	3.920	1	0	26.0	10.0	54.0	27.3	1750.	34.4	10.0	50.7	120
62	TDRS	2	29.000	1	0.000	0.000	0.000	0.0	0.0	4	50.000	0.000	6.145	3.290	1	0	27.0	10.0	54.0	27.3	1750.	35.4	10.0	50.7	125
63	TDRS	3	0.100	128	0.000	0.000	0.000	0.0	0.0	2	0.056	0.200*	6.145	3.290	1	0	-7.0	10.0	54.0	27.3	1750.	1.4	10.0	50.7	125
64	TDRS	4	0.050	312	5.250	0.000	0.004	0.0	17.4	0	0.000	0.100*	6.145	3.290	1	0	-6.0	10.0	54.0	27.3	1750.	2.4	10.0	50.7	125

Table 7 Interference Analysis:
Input Parameters

THERMAL NOISE SUMMARY 10:25:40

CAR- RIER	COM- PANY	EARTH - TO - SPACE POINT EIRP (DBW)	-ING LOSS (DB)	SPACE +LOSS* (DB)	RCV G/T (DB/K)	SPACE - TO - EARTH POINT EIRP (DBW)	-ING LOSS (DB)	SPACE +LOSS* (DB)	RCV G/T (DB/K)	C/KT - (DB/HZ) UP	DN	TOTAL	C/N - (DB) UP	DN	TOTAL	TOTAL THERMAL (PW0P)	S/N (DB)	NOISE EB/KT (DB)	SINGLE ENTRY INTER -FERENCE OBJECTIVE (PW0P)	S/I (DB)	C/I (DB)
1	ALAS	49.6	0.3	199.8	-0.6	7.2	0.0	196.2	23.7	77.5	63.3	63.1	32.9	18.7	18.5	2623.	55.8				22.4
2	ASC	81.0	0.3	199.8	-4.0	34.0	0.2	196.2	33.0	105.5	99.2	98.3	30.0	23.7	22.8	3660.	54.4		600.	62.2	
3	ASC	64.2	0.3	199.8	-4.0	22.0	0.2	196.2	33.0	88.7	87.2	84.9	17.9	16.4	14.1	10196.	49.9		600.	62.2	
4	ASC	81.0	0.3	199.8	-4.0	34.0	0.0	196.2	23.5	105.5	89.9	89.8	30.4	14.9	14.8		52.0			=53.2	22.0
5	ASC	78.0	0.3	199.8	-4.0	33.0	0.2	196.2	33.0	102.5	98.2	96.8	26.9	22.6	21.2			18.7			28.0
6	ASC	78.0	0.3	199.8	-4.0	33.0	0.0	196.2	18.4	102.5	83.8	83.7	32.6	13.9	13.9			14.8			20.0
7	ASC	65.0	0.3	199.8	-4.0	23.0	0.2	196.2	31.0	89.5	86.2	84.5	23.7	20.5	18.8			18.5			28.0
8	ASC	56.6	0.3	199.8	-4.0	14.1	0.2	196.2	33.0	81.1	79.3	77.1	20.7	18.9	16.7			15.2			27.1
9	ASC	48.4	0.0	199.8	-4.0	7.5	0.0	196.2	23.5	73.2	63.4	63.0	27.1	17.4	17.0			15.5			24.0
10	ASC	44.0	0.3	199.8	-4.0	1.0	0.2	196.2	31.0	68.5	64.2	62.8	22.4	18.2	16.8			15.3			24.0
11	AT&T	81.7	0.5	199.8	-5.0	28.6	0.2	196.2	42.0	66.0	63.9	61.8	30.0	27.8	25.8	7267.	51.4		3548.	54.5	
12	AT&T	82.7	0.3	199.8	-5.0	29.8	0.1	196.2	34.0	68.4	58.3	57.9	32.4	22.3	21.9	17846.	47.5		3548.	54.5	
13	AT&T	90.6	0.5	199.8	-5.0	35.0	0.2	196.2	42.0	113.9	109.2	107.9	38.3	33.6	32.3	1643.	57.8		600.	62.2	
14	AT&T	81.0	0.3	199.8	-5.0	35.0	0.1	196.2	26.5	104.5	93.8	93.5	28.9	18.3	17.9		55.2			=58.2	27.0
15	AT&T	82.1	0.3	199.8	-5.0	34.2	0.1	196.2	34.0	105.6	100.5	99.3	30.0	24.9	23.7			21.5			28.0
16	AT&T	83.9	0.5	199.8	-5.0	33.0	0.2	196.2	42.0	107.2	107.2	104.2	31.6	31.6	28.6			24.6			32.2
17	AT&T	66.6	0.3	199.8	-5.0	15.7	0.1	196.2	32.0	90.1	80.0	79.6	29.8	19.7	19.3			17.7			25.5
18	AT&T	67.0	0.3	199.8	-5.0	24.0	0.1	196.2	18.4	90.5	74.7	74.5	27.8	12.0	11.9			12.7			24.4
19	RCA	74.0	0.3	199.8	-4.8	30.0	0.2	196.2	34.0	60.1	58.5	56.2	24.1	22.5	20.2	5477.	52.6		600.	62.2	
20	RCA	81.0	0.3	199.8	-4.8	34.0	0.2	196.2	33.0	104.7	99.2	98.1	29.2	23.6	22.5	3659.	54.4		600.	62.2	
21	RCA	81.0	0.3	199.8	-4.8	34.0	0.2	196.2	33.0	104.7	99.2	98.1	29.2	23.6	22.5	4127.	53.8		600.	62.2	
22	RCA	69.9	0.3	199.8	-4.8	25.5	0.2	196.2	33.0	93.6	90.7	88.9	20.5	17.5	15.7	5423.	52.7		600.	62.2	
23	RCA	81.0	0.3	199.8	-4.8	34.0	0.2	196.2	33.0	104.7	99.2	98.1	29.2	23.6	22.5		59.8			67.0	=35.8
24	RCA	81.0	0.3	199.8	-4.8	34.0	0.2	196.2	32.3	104.7	98.5	97.6	29.2	22.9	22.0		59.3			67.0	=35.8
25	RCA	77.0	0.3	199.8	-4.8	33.0	0.1	196.2	28.5	100.7	93.8	93.0	28.2	21.2	20.4		51.5			65.5	=39.0
26	RCA	81.0	0.3	199.8	-4.8	34.0	0.2	196.2	31.0	104.7	97.2	96.5	29.2	21.6	20.9			18.7			28.0
27	RCA	78.5	0.3	199.8	-4.8	34.0	0.0	196.2	18.4	102.2	84.8	84.7	30.0	12.6	12.5			15.2			20.0
28	RCA	62.2	0.3	199.8	-4.8	15.0	0.2	196.2	31.0	85.9	78.2	77.5	25.8	18.1	17.4			15.6			27.1
29	RCA	55.0	0.0	199.8	-4.8	9.0	0.0	196.2	23.5	79.0	64.9	64.8	31.0	16.9	16.7			16.7			21.5
30	RCA	52.5	0.3	199.8	-4.8	0.0	0.2	196.2	30.0	76.2	62.2	62.0	30.6	16.5	16.4	175.	67.6				23.2
31	RCA	56.0	0.0	199.8	-4.8	10.0	0.0	196.2	12.0	80.0	54.4	54.4	23.5	-2.1	-2.1			14.6			11.0
32	W.U.	81.0	0.3	199.8	-4.0	34.0	0.2	196.2	37.4	105.5	103.6	101.4	29.9	28.0	25.8	8567.	50.7		600.	62.2	
33	W.U.	60.0	0.3	199.8	-4.0	18.0	0.2	196.2	37.4	84.5	87.6	82.7	17.9	21.0	16.2	3580.	54.5		600.	62.2	
34	W.U.	79.4	0.3	199.8	-4.0	34.0	0.2	196.2	34.0	103.9	100.2	98.6	28.3	24.6	23.1		60.6			67.0	=35.6
35	W.U.	78.0	0.3	199.8	-4.0	33.0	0.2	196.2	37.4	102.5	102.6	99.5	26.9	27.0	23.9			21.6			28.0
36	NPR	58.5	0.0	199.8	-4.0	16.5	0.0	196.2	22.5	83.3	71.4	71.2	30.7	18.9	18.6	39.	74.1				23.3
37	MUZK	64.2	0.3	199.8	-4.0	22.0	0.0	196.2	7.9	88.7	62.3	62.3	37.9	11.5	11.5	829.	60.8				2.1
38	A.P.	53.0	0.3	199.8	-4.0	12.0	0.0	196.2	17.8	77.5	62.2	62.1	31.7	16.4	16.3			14.6			2.4
39	A.P.	60.0	0.3	199.8	-4.0	18.6	0.0	196.2	17.8	84.5	68.8	68.7	32.1	16.4	16.3			14.6			24.0
40	MBS	61.0	0.3	199.8	-4.0	19.0	0.0	196.2	12.8	85.5	64.2	64.2	32.5	11.2	11.2	150.	68.2				22.0
41	EQU	63.0	0.3	199.8	-4.0	20.0	0.0	196.2	5.2	87.5	57.6	57.6	20.6	-9.3	-9.3			17.8			0.6
42	HUGH	81.0	0.3	199.8	-4.2	34.0	0.2	196.2	29.7	105.3	95.9	95.5	29.7	20.4	19.9	4989.	53.0		600.	62.2	
43	HUGH	81.0	0.3	199.8	-4.2	34.0	0.0	196.2	23.0	105.3	89.4	89.3	29.7	13.9	13.8		51.3			=53.4	22.0
44	HUGH	65.0	0.3	199.8	-4.2	24.0	0.2	196.2	29.7	89.3	85.9	84.3	23.2	19.9	18.3			16.2			28.0
45	HUGH	44.6	0.0	199.8	-4.2	3.7	0.0	196.2	23.0	69.2	59.1	58.7	26.2	16.1	15.7	395.	64.0				23.2
46	SPC	81.0	0.3	199.8	-2.8	34.0	0.2	196.2	30.0	106.7	96.2	95.8	31.2	20.6	20.3	6032.	52.2		600.	62.2	
47	SPC	73.0	0.3	199.8	-2.8	30.0	0.2	196.2	30.0	98.7	92.2	91.3	26.3	19.8	18.9	6710.	51.7		600.	62.2	
48	SPCW	71.5	0.3	199.8	-2.8	32.0	0.2	196.2	33.0	97.2	97.2	94.2	21.7	21.6	18.6	8802.	50.6		600.	62.2	
49	SPCW	71.5	0.3	199.8	-2.8	32.0	0.1	196.2	26.7	97.2	91.0	90.1	21.7	15.4	14.5		52.6			=53.6	22.0
50	SPCW	78.0	0.3	199.8	-2.8	35.7	0.2	196.2	30.0	103.7	97.9	96.9	25.2	19.3	18.3			15.9			28.0
51	PAN	76.7	0.0	199.8	-5.8	38.7	0.0	196.2	22.8	99.7	93.9	92.9	25.5	19.7	18.7		53.9			=51.6	22.0
52	PAN	81.0	0.3	199.8	-5.8	34.0	0.1	196.2	30.0	103.7	96.3	95.6	28.1	20.8	20.0	4833.	53.2		600.	62.2	
53	PAN	62.3	0.3	199.8	-5.8	25.3	0.1	196.2	30.0	85.0	87.6	83.1	18.4	21.1	16.6	3556.	54.5		600.	62.2	
54	PAN	43.7	0.0	199.8	-5.8	7.4	0.0	196.2	23.5	66.7	63.3	61.6	19.2	15.8	14.2			13.6			22.0
55	FINS	63.5	0.3	199.8	0.0	25.6	0.0	196.2	3.0	92.0	61.0	61.0	26.4	-4.6	-4.6			18.2			5.9
56	FINS	63.5	0.3	199.8	0.0	25.6	0.0	196.2	10.2	92.0	68.2	68.2	26.4	2.6	2.6			25.4			5.9
57	FINS	57.1	0.0	199.8	0.0	25.6	0.2	196.2	29.9	85.9	87.7	83.7	20.3	22.1	18.1			32.1			14.6
58	FINS	52.5	0.3	199.8	0.0	4.8	0.2	196.2	29.9	81.0	66.9	66.7	15.4	1.3	1.2			36.7			-6.3
59	FINS	58.5	0.3	199.8	0.0	19.5	0.2	196.2	29.9	87.0	81.6	80.5	26.8	21.5	20.4			18.6			28.0
60	FINS	78.0	0.3	199.8	0.0	37.6	0.2	196.2	29.9	106.5	99.7	98.9	30.9	24.1	23.3			21.1			28.0
61	TDRS	80.0	0.3	199.8	-5.1	34.4	0.2	196.2	29.9	103.4	96.5	95.7	27.8	20.9	20.1		57.7			=67.0	35.6
62	TDRS	81.0	0.3	199.8	-5.1	35.4	0.2	196.2	29.7	104.4	97.3	96.5	29.7	22.7	21.9			19.6			24.7
63	TDRS	47.0	0.3	199.8	-5.1	1.4	0.2	196.2	29.7	70.4	63.3	62.5	20.4	13.3	12.5			15.1			24.7
64	TDRS	48.0	0.3	199.8	-5.1	2.4	0.2	196.2	29.7	71.4	64.3	63.5	24.4	17.3	16.6	603.	62.2				24.7

Table 8 Interference Analysis:
Thermal Noise Summary

*** F O O T N O T E S ***

I N P U T P A R A M E T E R S

SIGNAL TYPE INDEX	POLARIZATION TYPE INDEX
0 = FDM/FM	0 = HORIZONTAL
1 = TV/FM	1 = VERTICAL
2 = DIGITAL	
3 = SCPC/PSK	2 = 20 DEG CANTED HORIZONTAL
4 = SCPC/FM	3 = 20 DEG CANTED VERTICAL
5 = CSSB/AM	
6 = SS/PSK	4 = LEFT-HAND CIRCULAR
	5 = RIGHT-HAND CIRCULAR

POLARIZATION ISOLATION MATRIX

DESIRED	INTERFERING SENSE 0	1	2	3	4	5
0	0.0	10.0	0.0	6.9	3.0	3.0
1	10.0	0.0	6.9	0.0	3.0	3.0
2	0.0	6.9	0.0	10.0	3.0	3.0
3	6.9	0.0	10.0	0.0	3.0	3.0
4	1.5	1.5	1.5	1.5	0.0	6.0
5	1.5	1.5	1.5	1.5	6.0	0.0

SPECTRA ASSUMED FOR INTERFERENCE INTO SCPC & PSK

TV/FM: 1.2 MHZ SPREADING ONLY

FDM/FM: GAUSSIAN, EXCEPT FOR THOSE MARKED WITH "+" UNDER SIGNAL TYPE

* INDICATES SCPC AND SMALL FDMA CARRIERS WHOSE TRANSPONDER FREQUENCY PLANS AVOID +- 2.0 MHZ AT THE TRANSPONDER CENTER.

"PLAN" UNDER CHANNEL SPACING INDICATES A FIXED FREQUENCY PLAN.

T H E R M A L N O I S E S U M M A R Y

+ POINTING LOSS INCLUDED IN THERMAL NOISE ONLY, NOT IN INTERFERENCE CALCULATIONS.

* FREE SPACE LOSS (10 DEG ELEV. ANG.) & ATMOSPHERIC LOSSES
= 199.6 + 0.2 DB (UPLINK)
= 196.1 + 0.1 DB (DOWNLINK)

= FOR TV/FM, INDICATES THE OBJECTIVE'S EQUIVALENT LEVEL FOR INTERFERENCE FROM ITSELF. FOR COMPARISON ONLY, NOT USED AS THE SINGLE ENTRY OBJECTIVE.

Table 9 Interference Analysis: Input Assumptions and Footnotes.

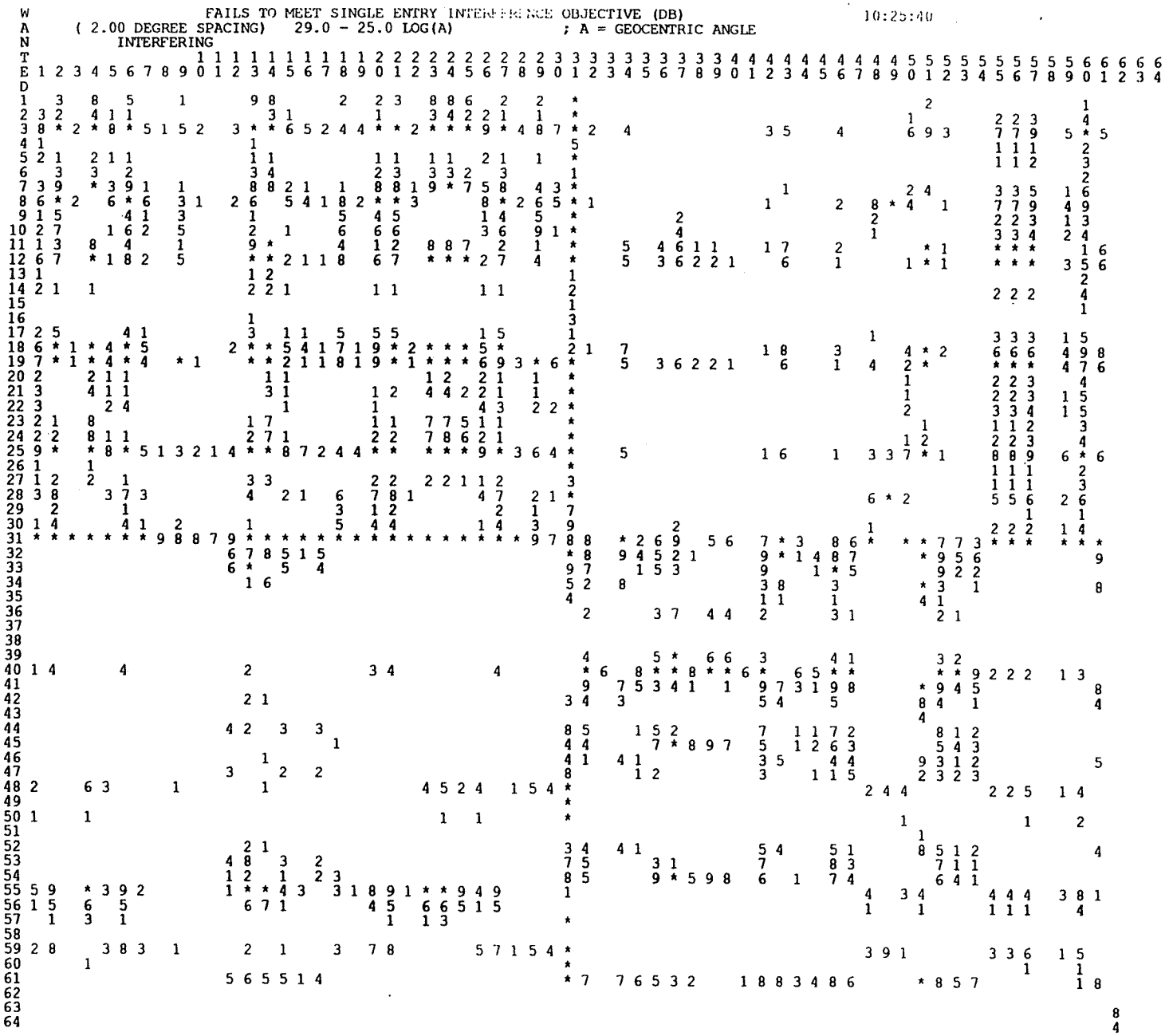


Table 10 Interference Summary

CERTIFICATION

I hereby certify, individually and for the applicant, that the statements made in this application are true, complete and correct to the best of my knowledge, information and belief, and are made in good faith.

ARC PROFESIONAL SERVICES GROUP, INC.

By: _____
L. Roy Patterson
Vice-President

Dated: January 29, 1990

my/jge02(1)certif