1-DSS-MP/ML-90
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3-DSS-MISC-90

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Domestic Facilities Division
Satellite Radio Branch

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

Request of

HUGHES COMMUNICATIONS GALAXY, INC.

for

Minor Modification of its
Authority to Construct, Launch and Operate
a C Band (Galaxy IV) and Ku Band (Galaxy A)
Domestic Communications Satellite

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

In the Matter of the Applications of HUGHES COMMUNICATIONS GALAXY, INC. For Authority to Construct and Launch a Ku Band Domestic Communications Satellite and a C Band Domestic Communications Satellite and to Operate those Satellites in Geostationary Orbit as Part of its Domestic Communications Satellite System	)	File No.

REQUEST FOR MODIFICATION

Hughes Communications Galaxy, Inc. ("HCG") hereby requests minor modification of its current authority to construct, launch, and operate a Ku band domestic communications satellite known as Galaxy A, currently assigned to the 99° West Longitude location, and of its current authority to construct, launch, and operate a C band domestic communications satellite known as Galaxy IV (previously known as Westar IVR), also assigned to 99° W.L.1/

As explained more fully below, the requested modification would combine the existing C and Ku band authorizations into a single hybrid satellite at the 99° location. The new hybrid satellite also will be known as Galaxy IV.

1/ See Hughes Communications Galaxy, Inc., 3 FCC Rcd 6989 (1988).

A. Overview of Modification

The requested modification proposes to use a single, hybrid satellite in lieu of the two single-band satellites that HCG is currently authorized to operate at the 99° location. Unlike certain hybrid spacecraft of the past, the proposed Galaxy IV hybrid, which will use the new Hughes Aircraft HS 601 bus, will provide full frequency reuse at both C and Ku bands, with full power on all transponders, i.e., 16 watts at C band and 50 watts at Ku band. The hybrid design will afford major efficiencies in spacecraft construction, launch and operation and will provide cross-strapping between frequency bands as described below.

This modification request does not seek the assignment of any new orbital locations. Rather, it merely proposes to use a single spacecraft bus at the location at which HCG is currently authorized to operate two separate single-band spacecraft. Nor does it seek any change in HCG's non-common carrier mode of operation. It does seek to incorporate 16 watt C band transponders, as previously applied for[1/], and to make certain other design improvements as detailed below, but these are only slight modifications to the overall design.

The technical specifications of the communications payload of the hybrid satellite are virtually identical to those

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1/ Application of Hughes Communications Galaxy, Inc. to increase Galaxy IV (Westar IVR) and Galaxy V (Westar VR) transponder power to 16 watts was filed with the Commission May 11, 1989.

previously authorized or applied for, with some minor changes to reflect design improvements made possible by recent technological advancements and to respond to current customer requirements. Significantly, none of these changes results in any increase in the interference levels generated into adjacent satellite systems. The HS 601 series spacecraft bus to be used for the hybrid satellite is very similar to that authorized for Galaxy A. This new generation spacecraft bus will allow full frequency re-use at both C and Ku bands, with no reduction from the power levels that are now standard on single-band satellites. Thus, the total technical changes to HCG's current authorizations are modest, except for the fact that only a single satellite is now proposed for the 99° location.

HCG's proposed schedule for Galaxy IV calls for a launch by March 1993, which is consistent with HCG's Ku band authorization at 99° but not with the requirement for the C band satellite at that location. Accordingly, HCG requests an extension of its C band launch date until March 1993 but, as explained below, intends to assure continuous C band coverage at 99° by means of the temporary location of another C band satellite at the 99° orbital position.

The modification sought by this request will provide significant benefits to the public. The use of a single hybrid satellite will realize substantial economies in spacecraft construction, launch and insurance costs. In contrast with previously authorized hybrid satellites, these economies can be achieved without any sacrifice in the technical performance or capabilities of the C band and Ku band communications payloads. The modifications described in the request will provide state-of-the-art satellite services to the public at both C band and Ku band and will provide full frequency reuse in each band.

B. General Technical Information

The Hughes Galaxy IV hybrid satellite will consist of C band and Ku band communications payloads collocated on an HS 601 series spacecraft bus. The technical specifications of the communications payloads are similar to those previously authorized by the Commission for Galaxy A and Galaxy IV (Westar IVR). Although the hybrid spacecraft bus is similar to the bus described in the Galaxy A application, converting to a hybrid design requires certain changes to that bus. The description below provides an overall description of the satellite, and highlights the respects in which the payloads are different from those previously authorized. Information not specified in this modification request, such as the adjacent satellite interference analyses, remains the same as that contained in the Galaxy IV and Galaxy A applications.

1. Satellite Operational Characteristics

a. Frequency Plan

Galaxy IV will operate in the C and Ku bands. The radio frequency and polarization plan are shown in Figures 1a and 1b; center frequency and polarization assignments are listed in Tables 1a and 1b.

The frequency and polarization plan for the C band portion of the communications payload is identical to the plan presented in the original Galaxy IV (Westar IVR) application, and consists of 24 active transponder channels, each with a bandwidth of 36 MHz. The Ku band portion of the communications payload contains 24 active transponder channels, consisting of eight wideband (54 MHz bandwidth) channels and 16 narrowband (27 MHz bandwidth) channels. The arrangement of the Ku band channels has been slightly modified from the Galaxy A authorization to better meet customer requirements.

Certain channels within the communications payload are equipped with "cross-strap" switches. These ground-controlled switches allow specific C band uplink channels to be retransmitted through Ku band downlink channels and, conversely, allow specific Ku band uplink channels to be retransmitted through C band downlink channels. The channels equipped with cross-strapping capabilities are listed in Table 2.

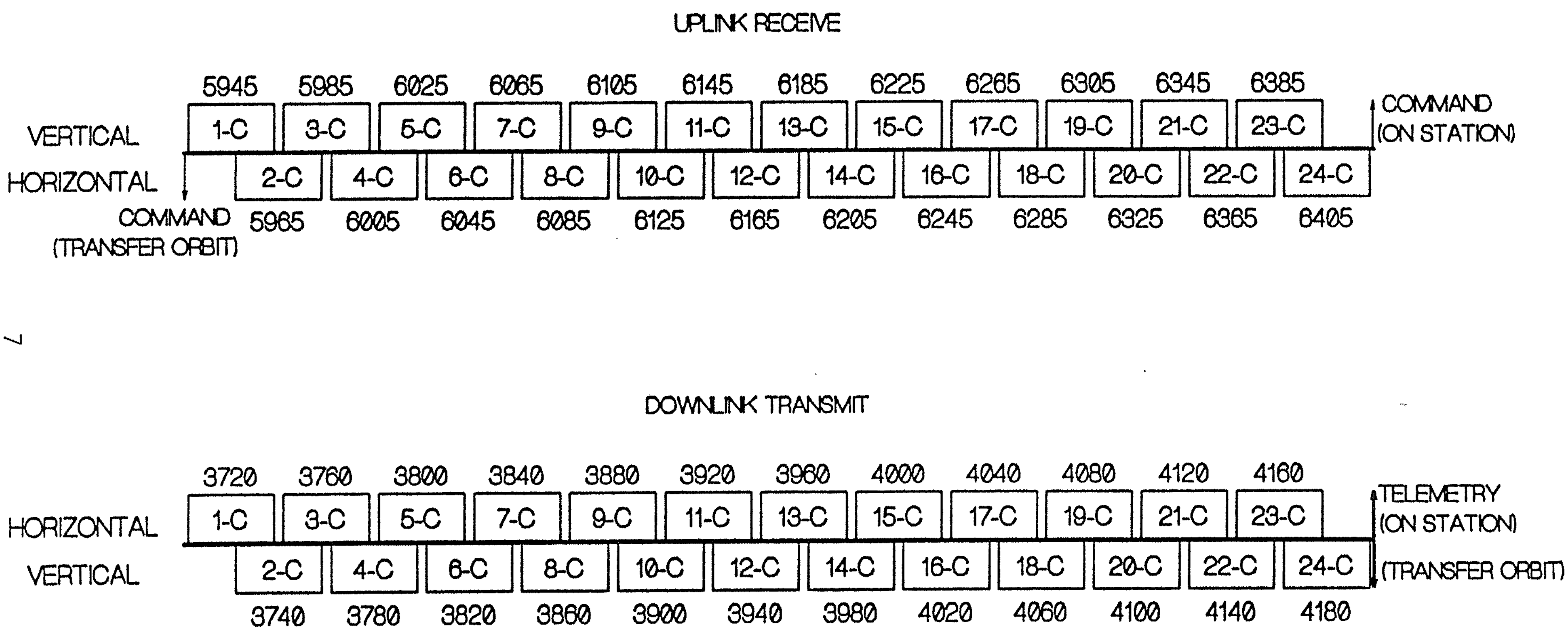


FIGURE 1a. C-Band FREQUENCY AND POLARIZATION PLAN

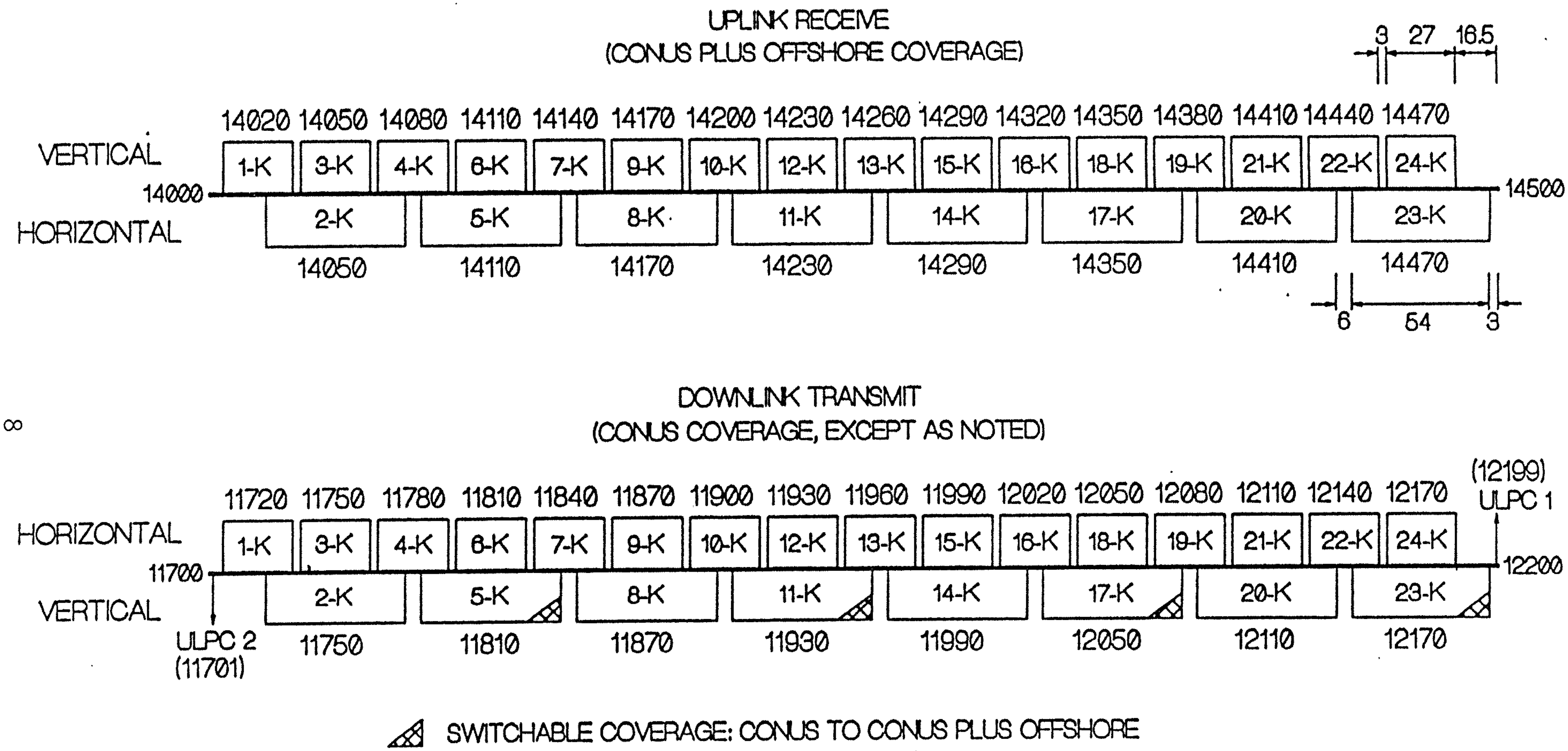


FIGURE 1b. Ku-BAND FREQUENCY AND POLARIZATION PLAN

TABLE 1a

C BAND FREQUENCY AND POLARIZATION ASSIGNMENTS

Channel	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Polarization	Downlink Center Frequency (MHz)	Transponder Bandwidth (MHz)
1	V	5945	H	3720	36
2	H	5965	V	3740	36
3	V	5985	H	3760	36
4	H	6005	V	3780	36
5	V	6025	H	3800	36
6	H	6045	V	3820	36
7	V	6065	H	3840	36
8	H	6085	V	3860	36
9	V	6105	H	3880	36
10	H	6125	V	3900	36
11	V	6145	H	3920	36
12	H	6165	V	3940	36
13	V	6185	H	3960	36
14	H	6205	V	3980	36
15	V	6225	H	4000	36
16	H	6245	V	4020	36
17	V	6265	H	4040	36
18	H	6285	V	4060	36
19	V	6305	H	4080	36
20	H	6325	V	4100	36
21	V	6345	H	4120	36
22	H	6365	V	4140	36
23	V	6385	H	4160	36
24	H	6405	V	4180	36

V = Vertical polarization
H = Horizontal polarization

TABLE 1b

KU BAND FREQUENCY AND POLARIZATION ASSIGNMENTS

Channel	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Polarization	Downlink Center Frequency (MHz)	Transponder Bandwidth (MHz)
1	V	14020	H	11720	27
2	H	14050	V	11750	54
3	V	14050	H	11750	27
4	V	14080	H	11780	27
5	H	14110	V	11810	54
6	V	14110	H	11810	27
7	V	14140	H	11840	27
8	H	14170	V	11870	54
9	V	14170	H	11870	27
10	V	14200	H	11900	27
11	H	14230	V	11930	54
12	V	14230	H	11930	27
13	V	14260	H	11960	27
14	H	14290	V	11990	54
15	V	14290	H	11990	27
16	V	14320	H	12020	27
17	H	14350	V	12050	54
18	V	14350	H	12050	27
19	V	14380	H	12080	27
20	H	14410	V	12110	54
21	V	14410	H	12110	27
22	V	14440	H	12140	27
23	H	14470	V	12170	54
24	V	14470	H	12170	27

V = Vertical polarization
H = Horizontal polarization

TABLE 2

FREQUENCY CROSS-STRAP CHANNELS

Uplink Channel	Downlink Channel Options*
18-C	18-C , 17-K
24-C	24-C , 23-K
17-K	17-K , 18-C
23-K	23-K , 24-C

* Selectable by ground command

In addition to the communications channel frequencies, two C band command uplink, two C band telemetry downlink, and two Ku band downlink beacon frequencies are shown in the plan. During transfer orbit, command signals will be received through a bicone antenna at the higher band-edge frequency. When the satellite is at final orbit position, the primary command uplink will be received at the lower band-edge frequency through the large C band communications reflector, with the bicone link available as a backup. The command uplink will use government-approved command encryption. The two telemetry frequencies shown in the plan will allow simultaneous transmission of two separate or redundant telemetry data streams. The vertically and horizontally polarized downlink beacon signals will be continuously transmitted by the satellite and used by earth station operators as a calibrated reference to compensate for rain attenuation and to adjust antenna pointing.

The satellite communication subsystem will include appropriate filtering at the inputs and outputs of the satellite to minimize internal interchannel interference, noise effects outside the satellite frequency band, and out-of-band spurious transmissions.

b. Emission Designators

Commands to the satellite from the TT&C station will be angle-modulated with a large deviation on the uplink carrier. The satellite will be equipped with government-approved command encryption equipment in order to secure command transmissions.

Telemetry data from the satellite will be angle-modulated on the downlink carrier. The emission designators for the communications, TT&C and downlink beacon signals are as follows:

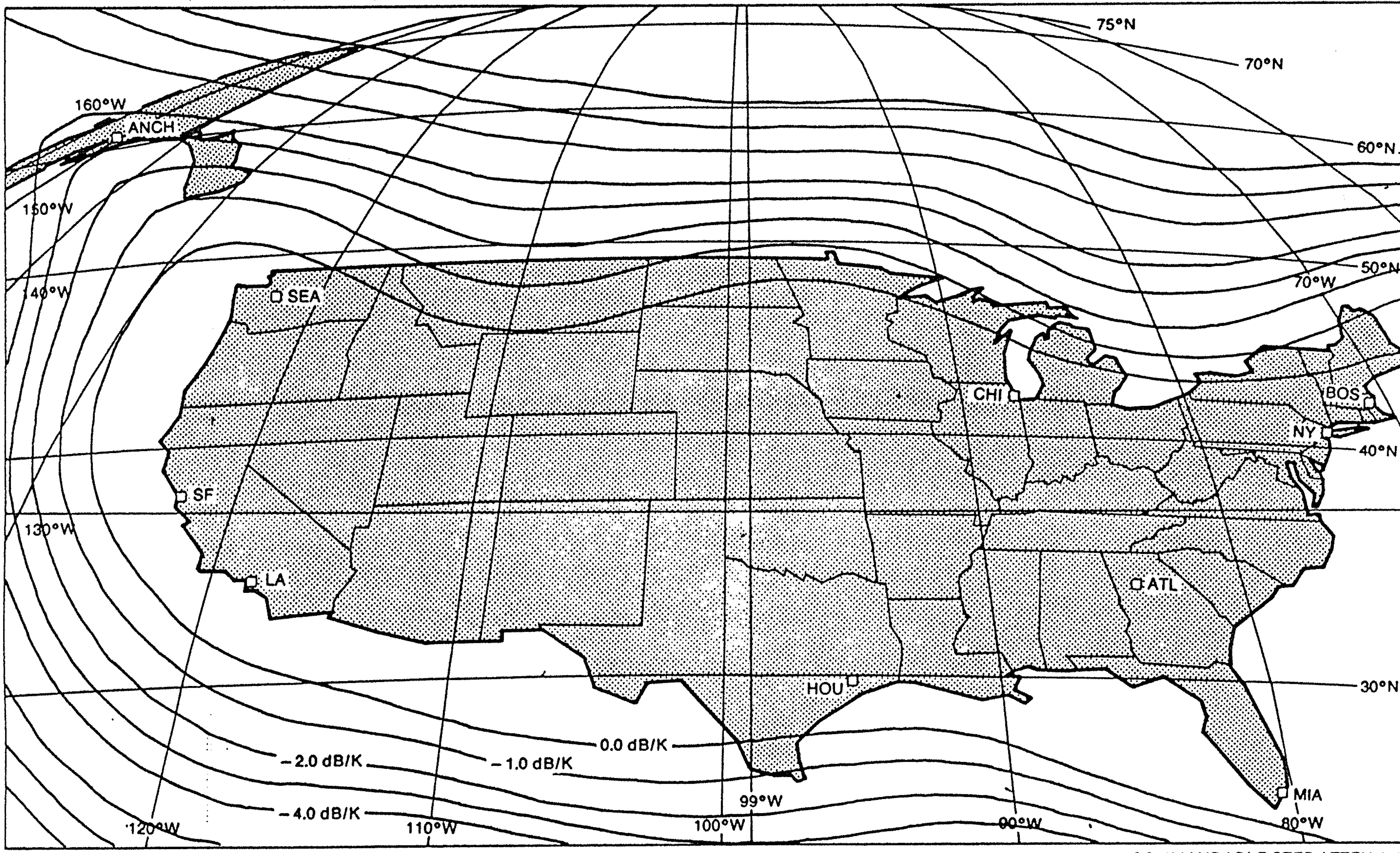
Signal	Emission Designator
Command	300KF9DXX
Telemetry/Ranging	120KF9DXX
Downlink Beacon	25KONON
Single carrier TV	24M0F3FNN
Dual carrier TV	23M3F8FNF
High Speed Data	25M7G1WDN
Digital (T1) data	1M17G1WDF
Digital voice	24K3G1WDF
Digital (64 kbps) data	48K6G1WDF
FM Audio (Narrowband)	50K0F3EJF
FM Audio (Wideband)	150KF3EJF

c. Communications Coverage

The C band communications coverage pattern is essentially identical to the pattern specified in the Galaxy IV (Westar IVR) application. The C band receive and transmit patterns provide shaped beam coverage of the contiguous United States ("CONUS"), Alaska, Hawaii, Puerto Rico, and U.S. Virgin Islands. Representative C band receive gain-to-noise temperature ratio ("G/T") and Effective Isotropic Radiated Power ("EIRP") contours are shown in Figures 2a through 2d. Values for Saturation Flux Density ("SFD") for C band communications may be calculated by using the equations specified at the top of Figures 2a and 2b.

The receive pattern for Ku band communications provides coverage over CONUS, Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands. The Ku band transmit pattern provides CONUS coverage for all Ku band downlinks. In addition, the transmit beams of four specific Ku band channels can be switched into "Offshore" mode. In Offshore mode, CONUS coverage is expanded to include Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands. Representative Ku band G/T and EIRP contours are shown in Figures 3a through 3e. Satellite SFD may be calculated for Ku band communications by using the equations specified at the top of Figures 3a and 3b.

PEAK G/T = 5.70 dB/K, SFD = – (G/T + 86.5)



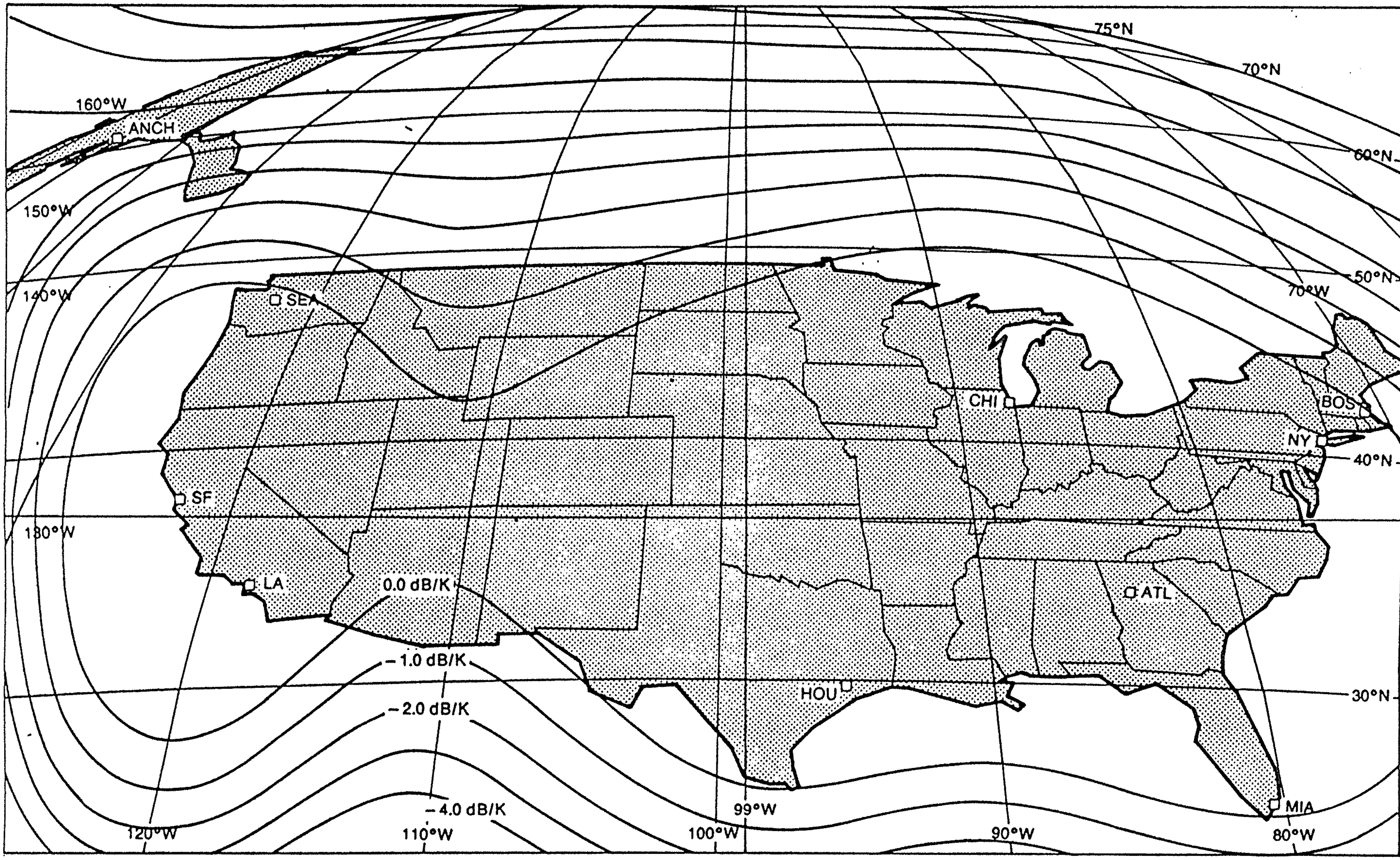
COMMANDABLE STEP ATTEN 4 dB

FIGURE 2a. C-BAND G/T COVERAGE (HORIZONTAL RECEIVE)

HC 890512
19 SEPT 89

HUGHES

PEAK G/T = 3.73 dB/K, SFD = – (G/T + 86.5)



COMMANDABLE STEP ATTEN 4 dB

FIGURE 2b. C-BAND G/T COVERAGE (VERTICAL RECEIVE)

HC 890511
19 SEPT 89

HUGHES

PEAK EIRP = 41.15 dBW

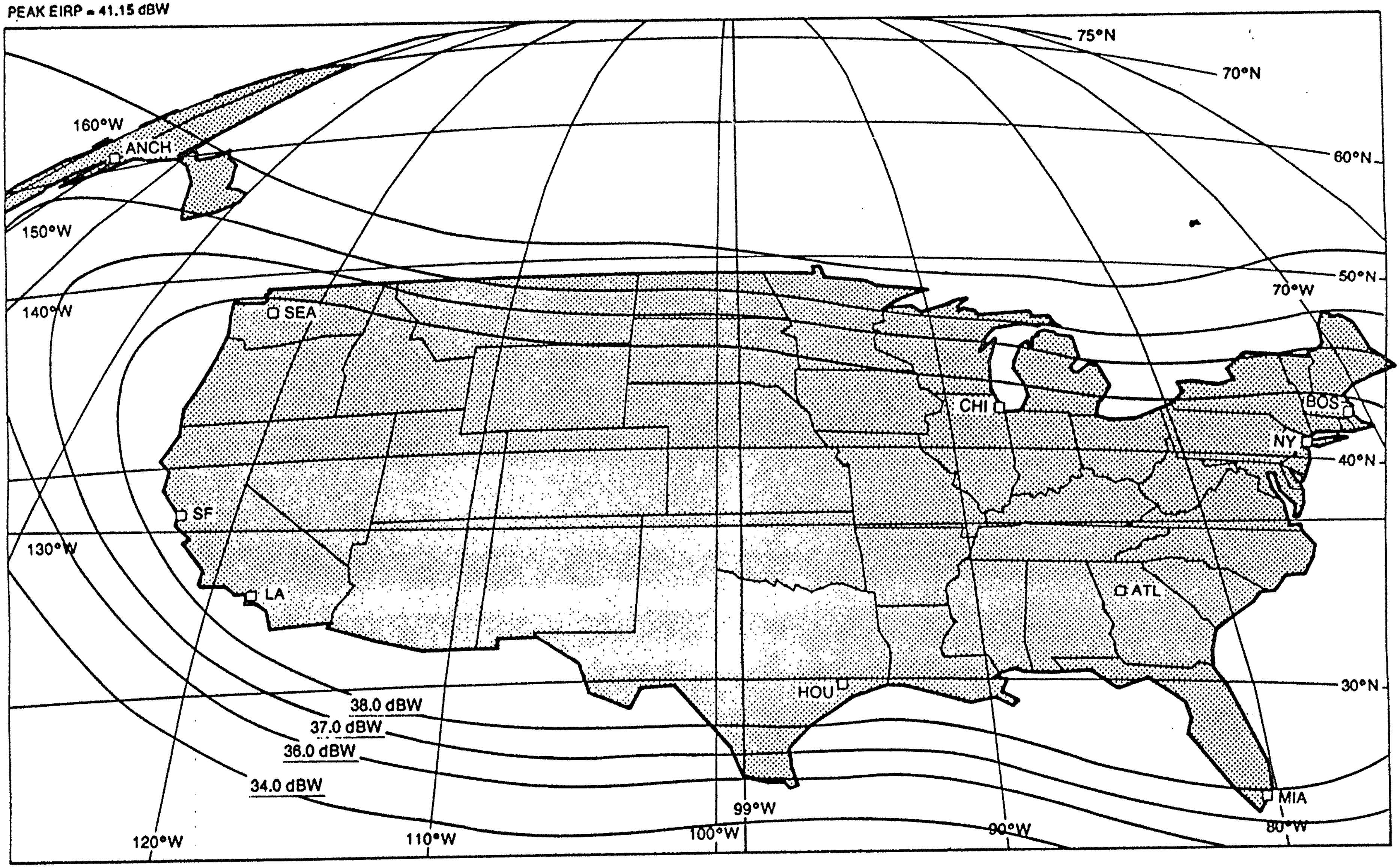


FIGURE 2c. C-BAND EIRP COVERAGE (HORIZONTAL TRANSMIT)

HC 890509
19 SEPT 89

HUGHES

PEAK EIRP = 40.51 dBW

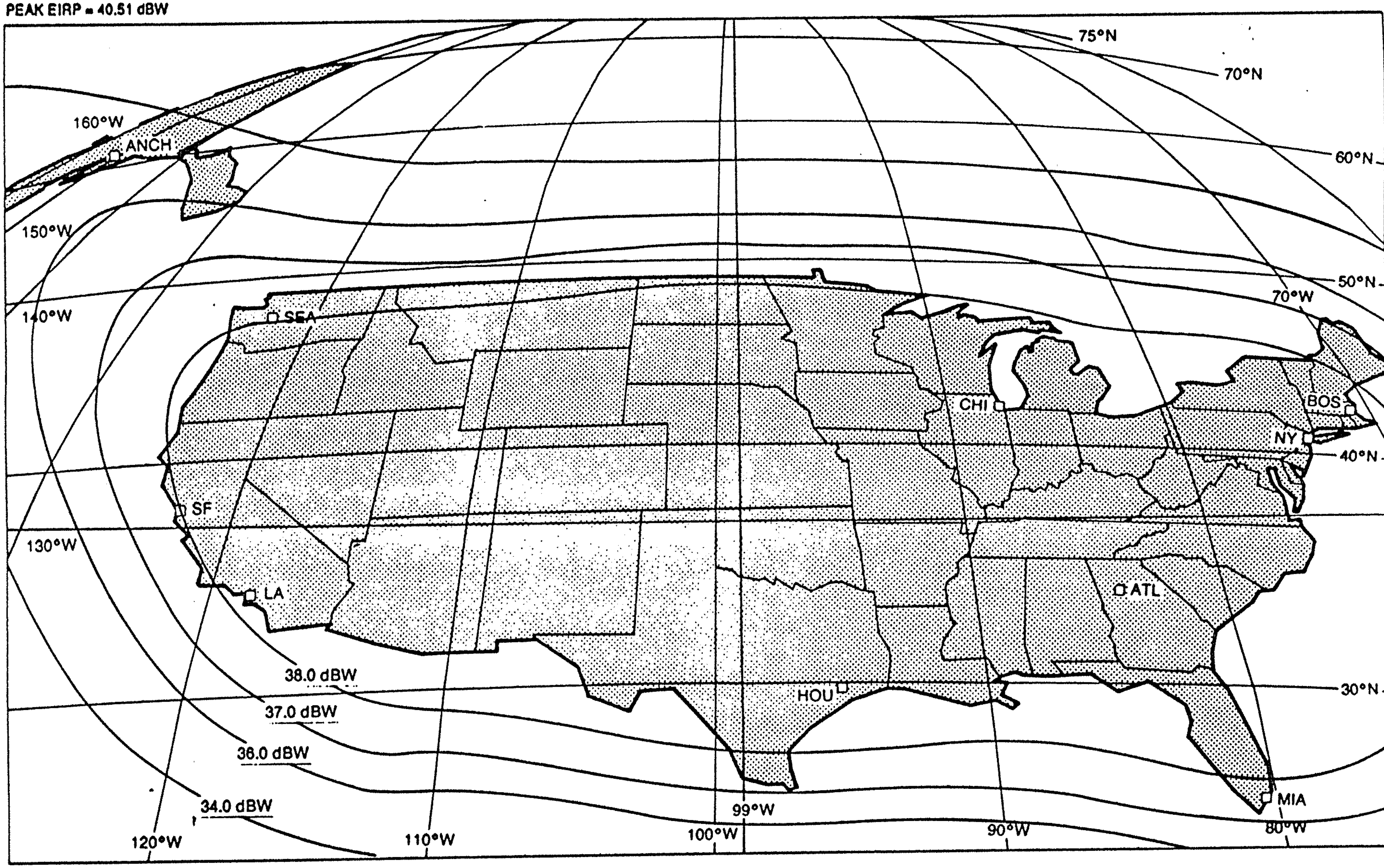


FIGURE 2d. C-BAND EIRP COVERAGE (VERTICAL TRANSMIT)

HC 890510
19 SEPT 89

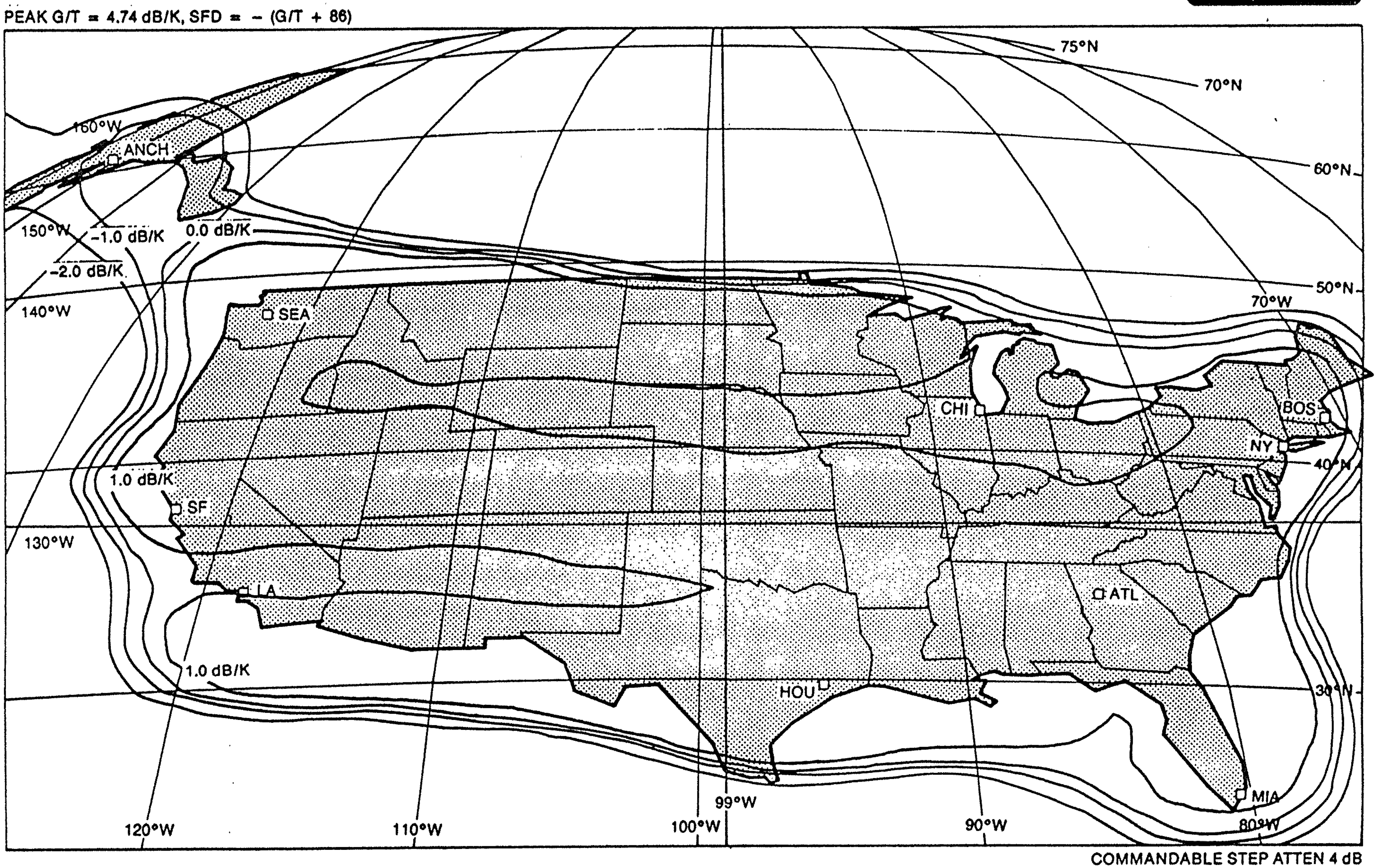


FIGURE 3a. Ku-BAND G/T COVERAGE (HORIZONTAL RECEIVE)

HC 890502
19 SEPT 89

HUGHES

PEAK G/T = 5.11 dB/K, SFD = − (G/T + 86)

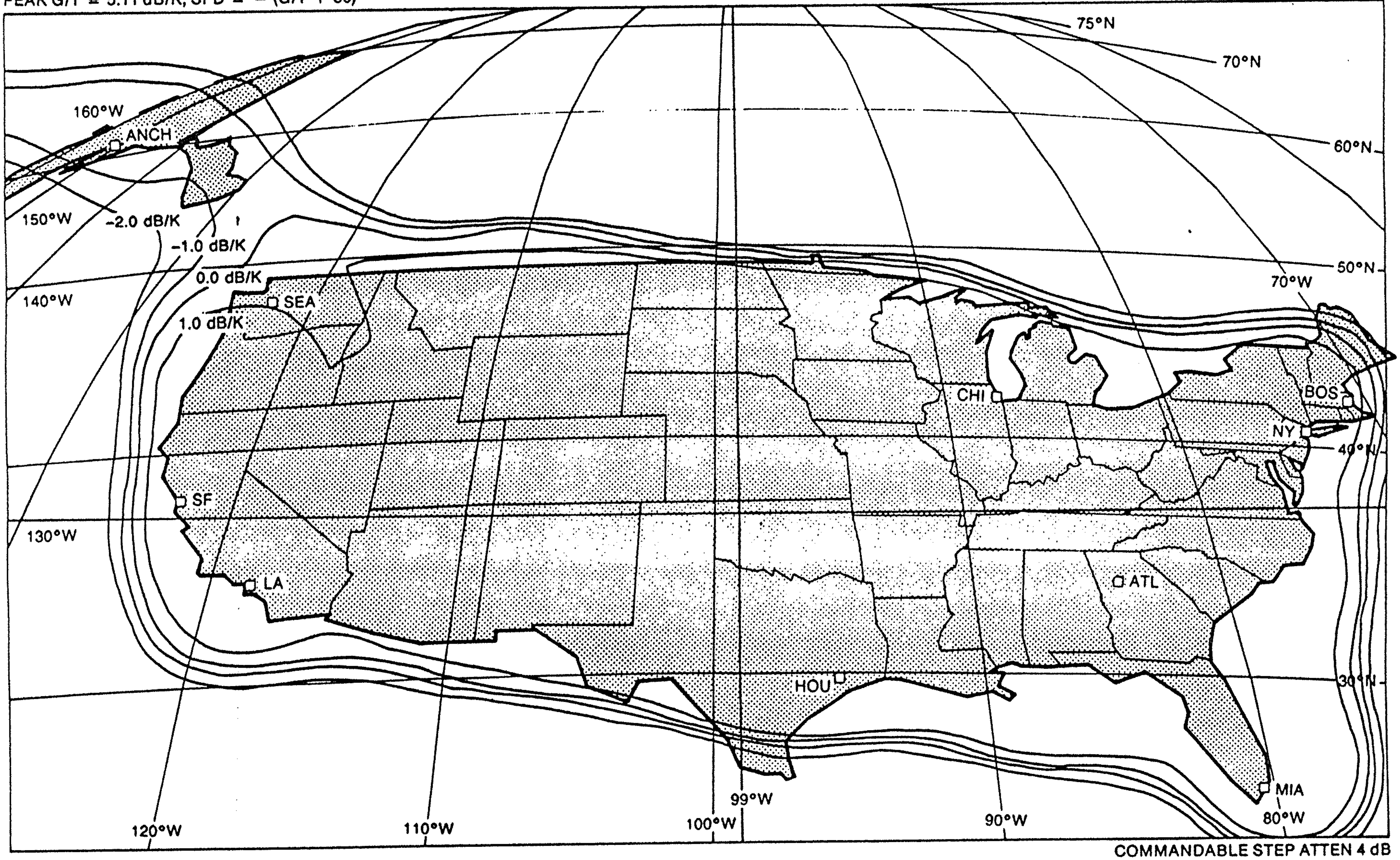


FIGURE 3b. Ku-BAND G/T COVERAGE (VERTICAL RECEIVE)

HC 890501
19 SEPT 89

HUGHES

PEAK EIRP = 48.57 dBW

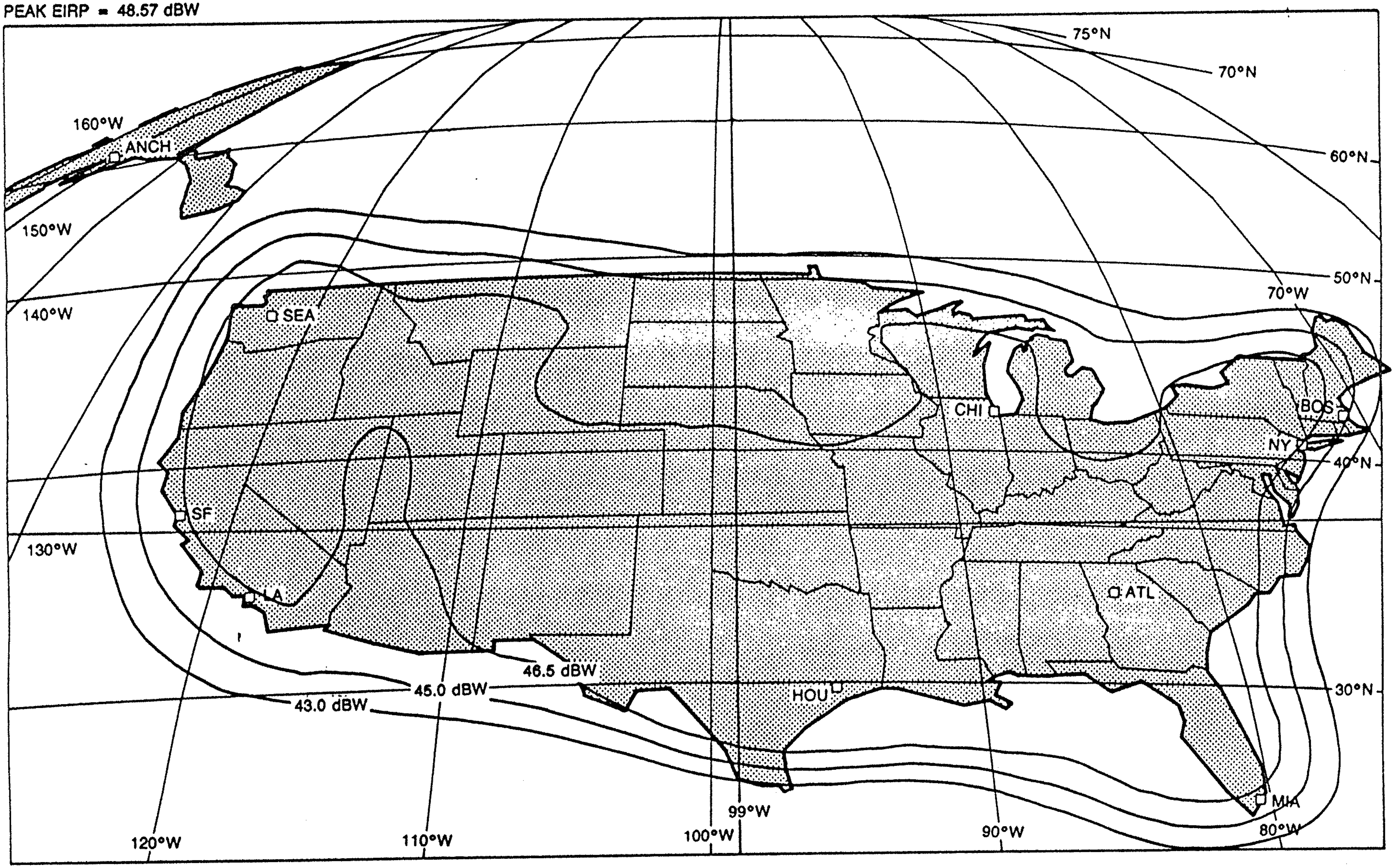


FIGURE 3c. Ku-BAND EIRP COVERAGE (HORIZONTAL TRANSMIT, CONUS ONLY)

HC 890504
19 SEPT 89

PEAK EIRP = 48.46 dBW

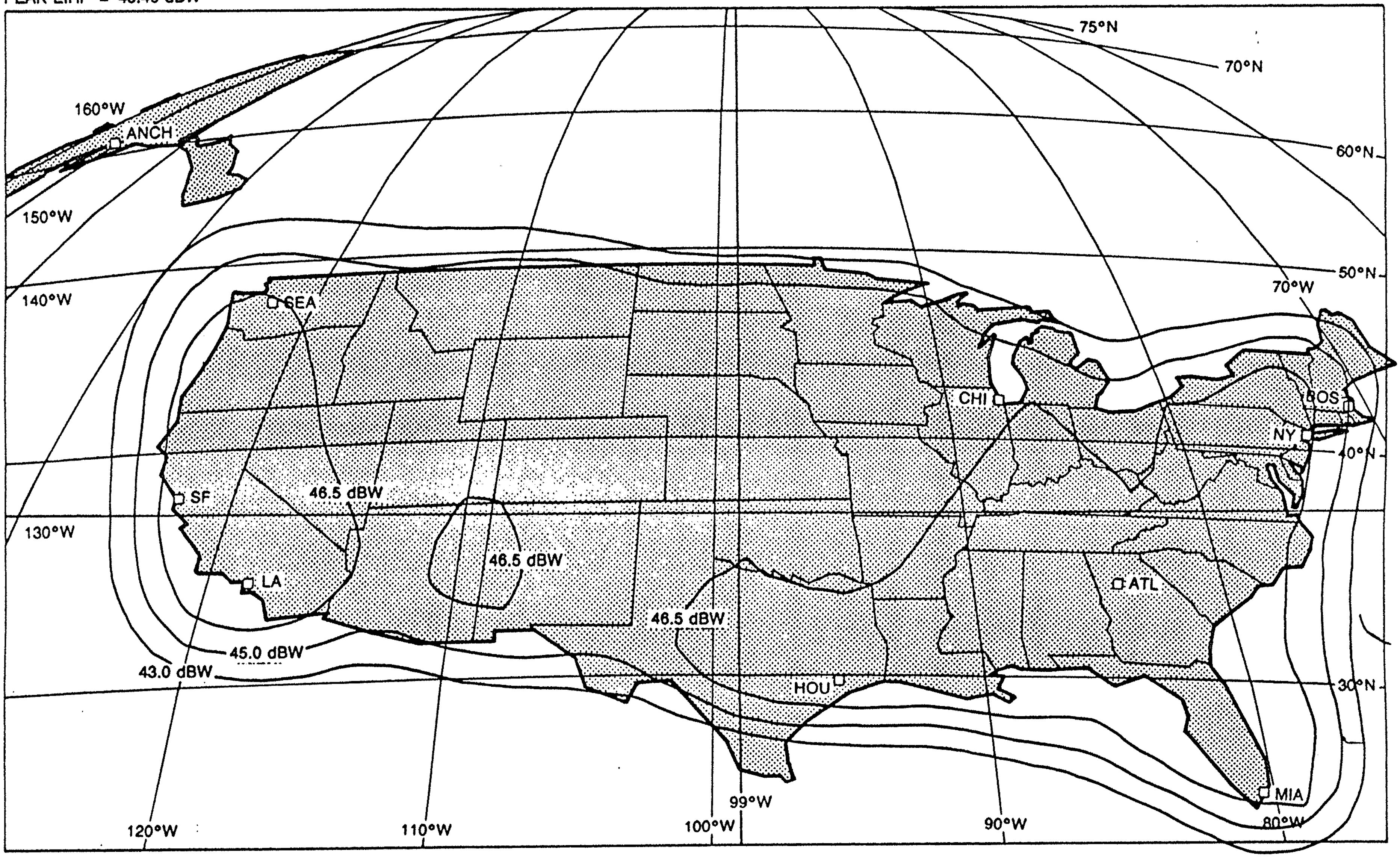


FIGURE 3d. Ku-BAND EIRP COVERAGE (VERTICAL TRANSMIT, CONUS ONLY)

HC 890505
19 SEPT 89

HUGHES

PEAK EIRP = 48.04 dBW

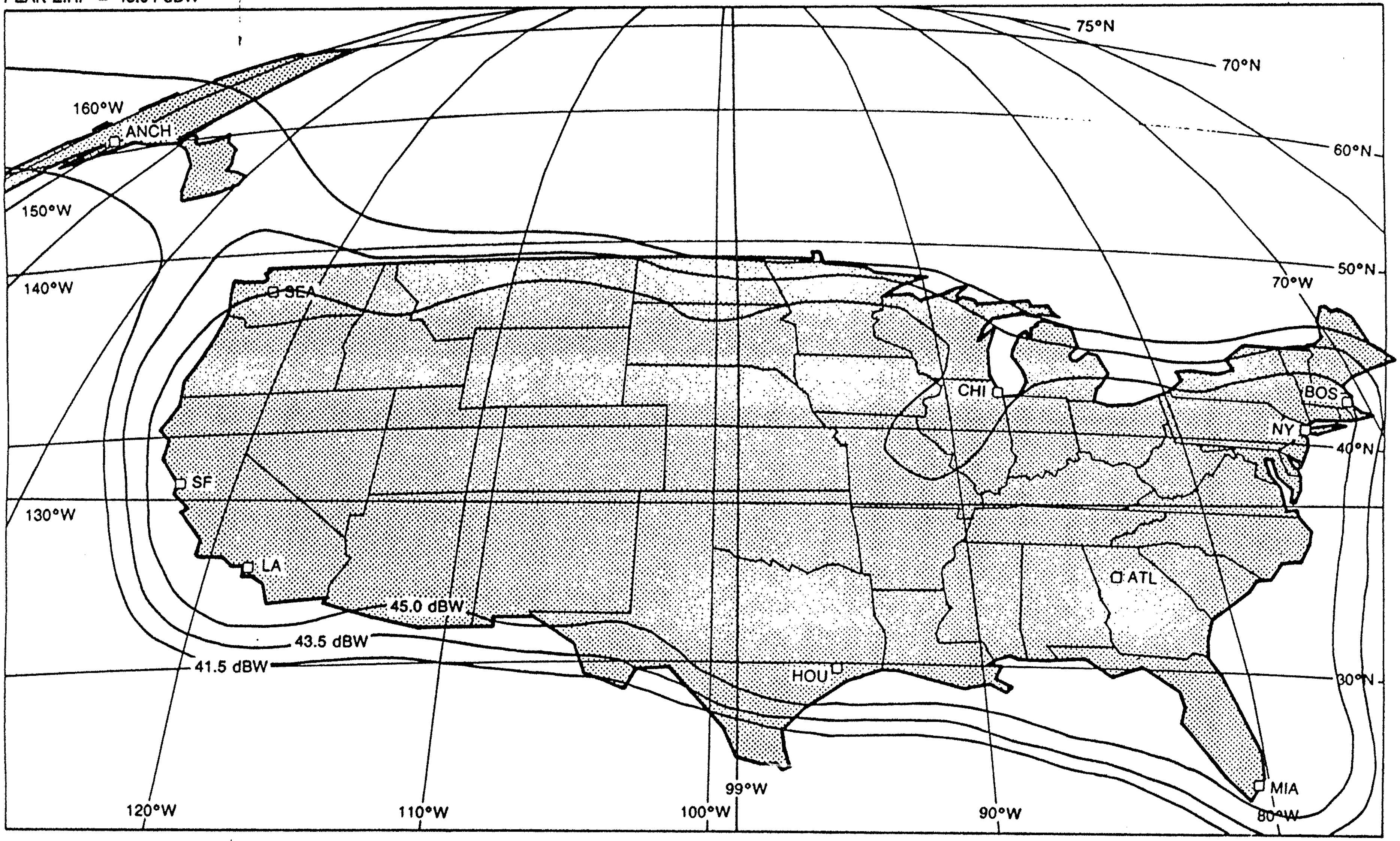


FIGURE 3e. Ku-BAND EIRP COVERAGE (VERTICAL TRANSMIT, CONUS & OFFSHORE)

HC 890503
19 SEPT 89

2. Satellite Characteristics

The on-orbit configuration of the satellite is illustrated in Figure 4. Major spacecraft characteristics are summarized in Table 3.

a. Spacecraft Bus

The HS 601 series spacecraft bus used for Galaxy IV is fundamentally the same as the bus described in the Galaxy A application. The weight and power generation capabilities of the spacecraft have been increased in response to the larger communications payload. The weight and power budget estimates presented in Tables 4 and 5 are based upon a mission life of 12 years.

TABLE 3

SPACECRAFT CHARACTERISTICS

General	
Spacecraft bus	Hughes, HS 601
Launch vehicle	Ariane, Titan, STS, Atlas
Stabilization	
Transfer orbit	Spin stabilized
On station	Body stabilized
Mission life	12 years
Design life	15 years
Eclipse capability	100 percent (48 channels)
Stationkeeping	
North-South (orbital inclination)	±0.05 degrees
East-West (longitudinal drift)	±0.05 degrees
Antenna pointing	
East-West North-South	±0.14 degrees azimuth ±0.14 degrees elevation
Beam rotation (antenna axis attitude)	±0.25 degrees

TABLE 3 (cont'd.)

Communications	C Band	Ku Band
Frequency		
Receive	5925-6425 MHz	14000-14500 MHz
Transmit	3700-4200 MHz	11700-12200 MHz
Polarization	Hor/Ver Linear	Hor/Ver Linear
Number of transponders	24	24
Transponder bandwidth	36 MHz	27 MHz (16 ch.) 54 MHz (8 ch.)
Receive G/T (CONUS)	-1.0 dB/K	2.0 dB/K
Transponder gain (@ 0dB attenuator step)	112 dB	114.6 dB
Receive Saturation Flux Density (CONUS)	-90 to -76 dBW/M^2 (2 dB increments)	-92 to -72 dBW/M^2 (2 dB increments)
Transmit EIRP (CONUS)	38 dBW	45 dBW
Transmitter RF power	16 Watts	50 Watts
Transmitter redundancy	30 for 24	30 for 24

Emission limitations (percentage of authorized bandwidth)	
50 to 100%	>25 dB attenuation in any 4 kHz
100 to 250%	>35 dB attenuation in any 4 kHz
Greater than 250%	>61 dB attenuation in any 4 kHz

Table 3 (cont'd.)

<u>Tracking, Telemetry and Command</u>		
Frequency		
Command, Ranging and Tracking Beacon	5925 to 5930 MHz transfer orbit 6420 to 6425 MHz on station	
Telemetry and Ranging	2 signals within 4198 to 4200 MHz	
Polarization	<u>Transfer Orbit</u>	<u>On Station</u>
Command, Ranging	Horizontal, linear	Vertical, linear
Telemetry, Ranging	Vertical, linear	Horizontal, linear
Bandwidth		
Command, Ranging	300 kHz	
Telemetry/Ranging	120 kHz	
Telemetry EIRP		
Transfer Orbit	10.0 dBW maximum	
On Station	15.9 dBW maximum	
Command Threshold (flux density)		
Transfer Orbit	-91.0 dBW/m^2	
On Station	-105.0 dBW/m^2	

TABLE 4
WEIGHT BUDGET

Category	Weight, lbs.
Communications subsystem weight	560
Bus weight	1,980
Estimated spacecraft dry weight	2,540
Margin	90
Maximum allowable dry weight (Ariane IV, shared)	2,630
Fuel, expendables	2,875
Total launch weight	5,505

TABLE 5
POWER BUDGET

Category	Power, Watts
Communications subsystem power	3,437
Bus power	341
Total Power Requirement	3,778
End-of-Life array capability (12 years)	4,133
End-of-Life Margin	355

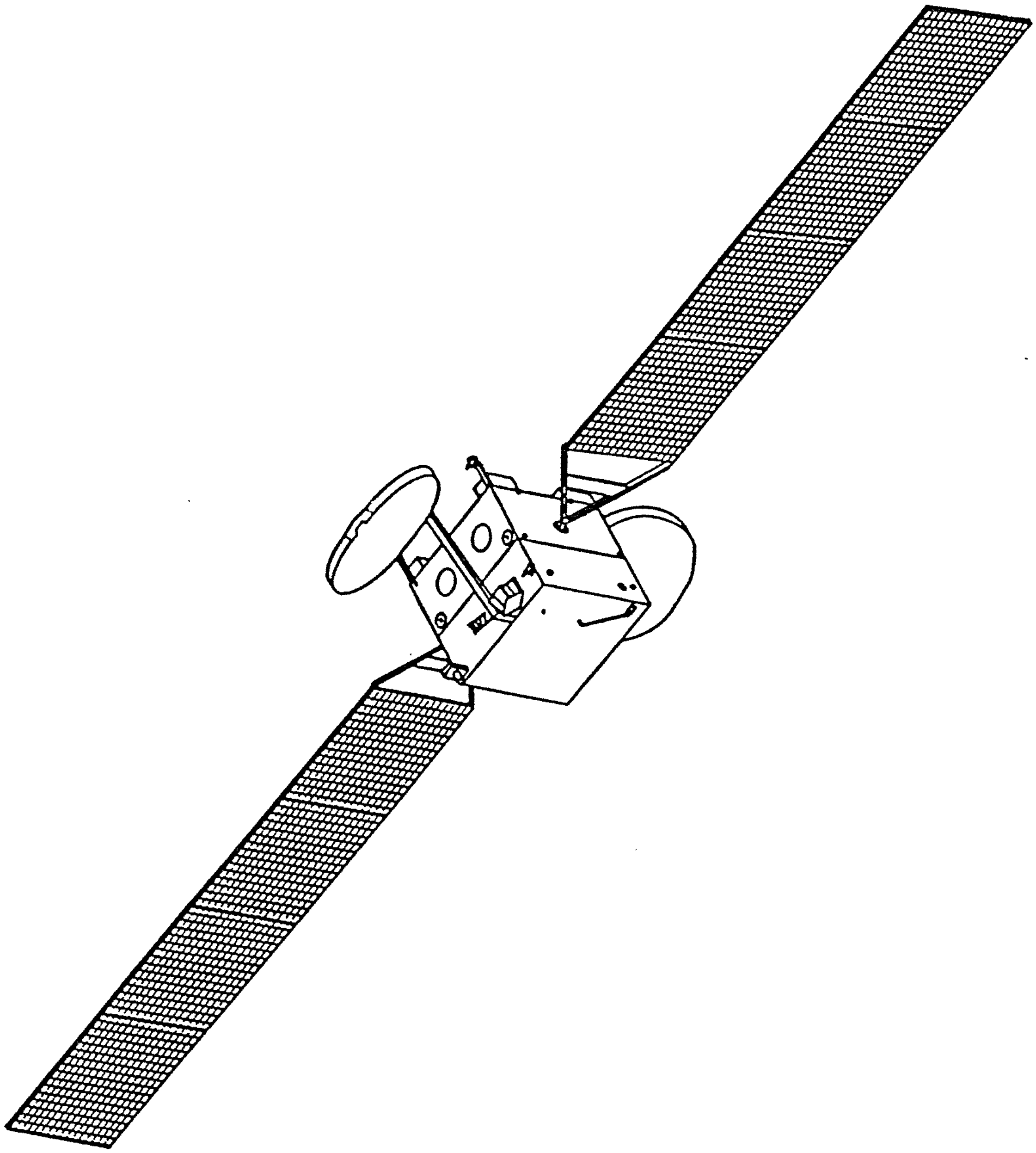


FIGURE 4. GALAXY IV ON-ORBIT CONFIGURATION

b. <u>Antenna Subsystem</u>

The satellite antenna subsystem contains two parabolic reflectors each consisting of two polarization-selective gridded offset paraboloids sharing the same aperture. One of these reflectors is used for C band communications; the other reflector is used for Ku band communications. The four multihorn feed assemblies which feed the reflectors are frequency diplexed to allow each assembly to be used for transmit and receive functions.

c. <u>Communications Subsystem</u>

The communications subsystem consists of two communications repeaters: a 24 channel C band repeater employing 16 watt solid state power amplifiers (SSPA's), and a 24 channel Ku band repeater employing 50 watt traveling wave tube amplifiers (TWTA's). Except for the limited frequency cross-strapping capabilities previously described, the C band and Ku band repeaters are essentially independent of each other. A functional block diagram of the C band and Ku band repeaters is presented in Figure 5.

Except for the modifications listed below and the rearrangement of the Ku band channel plan previously described, the key features and characteristics of the C band and Ku band repeater designs are the same as those described in the original applications. The only significant changes made to the C band repeater are (1) the replacement of the 4-step, 3-dB increment commandable step attenuator with an 8-step, 2-dB increment step attenuator, and (2) the use of ring redundancy for the SSPA's instead of a channel-bank redundancy scheme. The modified step attenuator provides greater operational flexibility for each transponder channel. Use of ring redundancy greatly enhances the overall availability and reliability of the C band communications channels.

The only significant changes made to the Ku band repeater are (1) the reduction of the TWTA RF power from 60 watts to 50 watts, and (2) the elimination of the Variable Power Dividers which followed the TWTA (this device was used to switch to half-CONUS mode, which is no longer a feature of the Ku band repeater).

None of the above modifications results in an increase of the potential interference level into adjacent satellite systems. In fact, the modifications to the Ku band payload actually <u>decrease</u> that payload's interference potential. No further interference analysis is therefore necessitated by these changes.2/

2/ In connection with the joint request of Satellite Transponder Leasing Corporation (STLC") and HCG to locate SBS-6 at the 99° location on a temporary basis, see File No. 8141-DSS-MISC-89, Contel ASC and AT&T each filed comments that raised certain concerns about coordinating their satellites with Galaxy A at 99°. In their Joint Reply Comments (filed September 20, 1989) HCG and STLC explained how those concerns could be readily resolved. HCG's solution is unaffected by this modification.

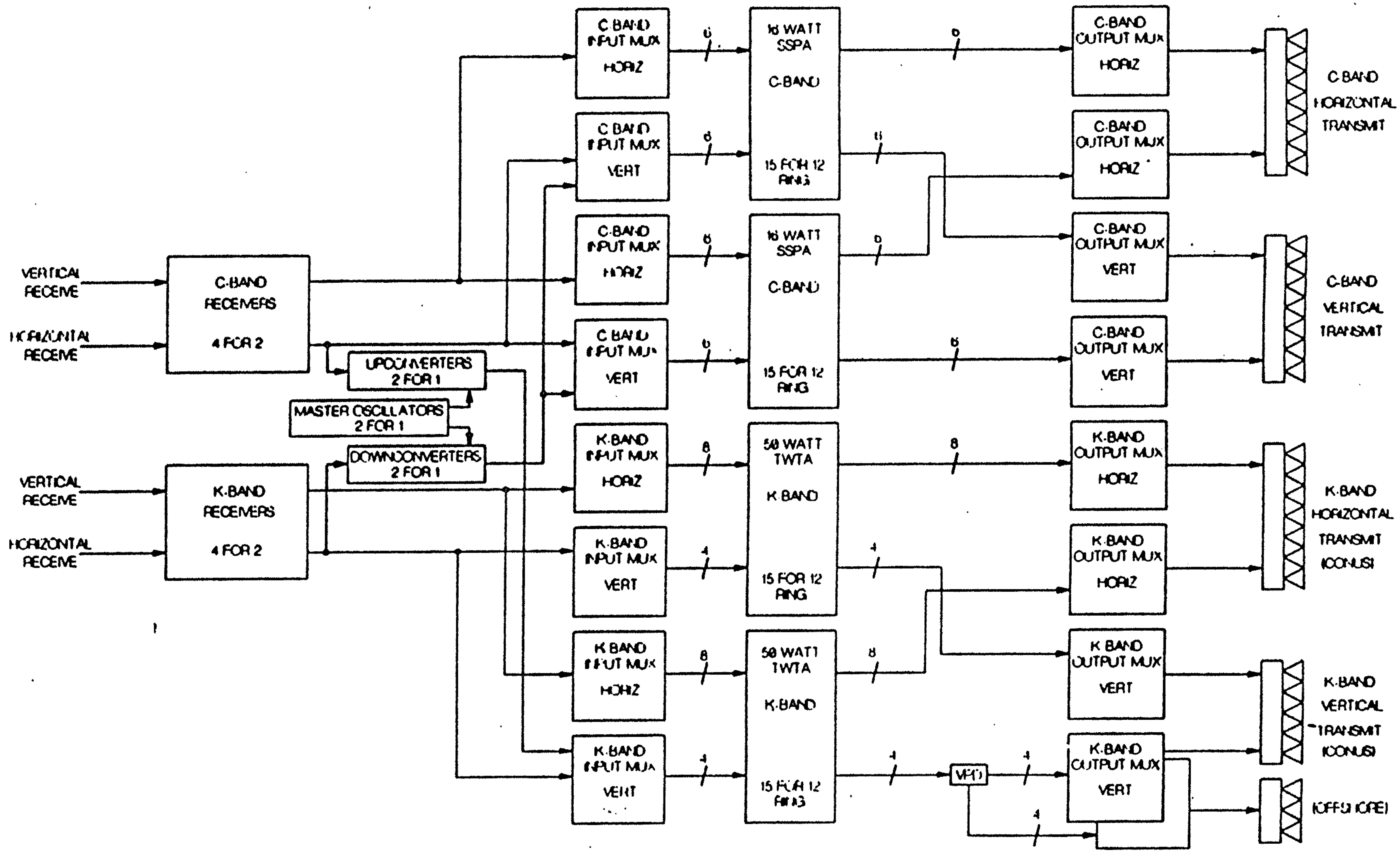


FIGURE 5. REPEATER BLOCK DIAGRAM

d. Telemetry, Tracking and Command ("TT&C")

The TT&C subsystem to be used in the hybrid satellite is substantially equivalent to the TT&C subsystem described in the Galaxy IV (Westar IVR) application. The only major difference between the hybrid's TT&C subsystem and Westar IVR's subsystem is the elimination of the beacon tracking function within the command/track receiver. Beacon tracking was deemed to be unnecessary since the attitude control performance of the satellite using earth sensor references was determined to satisfy the ± 0.14° (E-W, N-S) antenna pointing objective. The TT&C subsystem major parameters have been summarized in Table 3.

e. Satellite Useful Lifetime

The design lifetime of the satellite in orbit (excluding fuel limitations) is 15 years. This has been determined by a conservative evaluation of the effect of the synchronous orbit environment on the solar array, the effect of the charge-discharge cycling on the life of the batteries, and the wearout of the TWTAs. The mass allocation of propellant for spacecraft stationkeeping is 12 years. To enhance the probability of survival, spacecraft equipment will be redundant wherever possible. Materials and processes will be selected so that aging or wearing effects will not adversely affect spacecraft performance over the estimated life.

f. Satellite Stationkeeping

Inclination of the satellite orbit will be maintained to ±0.05 degree or less, and the satellite will be maintained to within ±0.05 degree of the nominal longitude position. Attitude of the satellite will be maintained to an accuracy consistent with the achievement of the specified communications performance, after taking into account all error sources (e.g., attitude perturbations, thermal distortions, misalignments, orbital tolerances, and thruster perturbations).

In addition to the propellant required for operational attitude and orbital control, extra propellant will be incorporated to provide correction of the initial orbit and initial attitude acquisition. Sufficient propellant will be included in the satellite to permit a 12-year operational life.

C. Schedule

Hughes Aircraft Company has already begun construction of certain aspects of the C band and Ku band communications payloads that previously have been authorized, as well as the HS 601 satellite bus authorized for Galaxy A. By separate letter filed today, HCG is requesting a Section 319(d) waiver to permit it to commence construction of the modified design immediately, at its own risk. HCG intends to launch Galaxy IV in March 1993. This date is consistent with HCG's current Ku band launch milestone[3/], but represents an extension of its C band launch milestone, which is May 1991. An extension of the C band launch date is required in order to accommodate the change in design and the need to launch both payloads of a hybrid satellite at the same time. Accordingly, HCG respectfully requests an extension

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3/ Galaxy A is required to be launched by July 1993.

of its C band milestone dates regarding launch and operation.

HCG's current C band satellite at the 99° location, Westar IV, is expected to reach its end-of-life in mid-1991. Notwithstanding the gap between the end-of-life of Westar IV and the launch of Galaxy IV, HCG is committed to provide continuous service to its C band customers at 99°. HCG is currently exploring a variety of options to provide this interim capacity. One of the options involves locating one of HCG's C band satellites at the 99° location (upon Commission approval) on an interim basis from the end-of-life of Westar IV until the launch of the Galaxy IV hybrid.4/ In addition, HCG is currently exploring the possible use of other spacecraft, outside the Galaxy fleet, for interim C band capacity at 99° W.L. In any event, HCG will take whatever steps are necessary, including necessary filings with the Commission, to ensure that there is no lapse in C band coverage at 99° due to the time needed to construct and launch the hybrid.

D. Satellite Costs

HCG's financial qualifications to construct, launch, and operate Galaxy IV (Westar IVR) and Galaxy A have already been demonstrated. The projected cost for the Galaxy IV hybrid satellite is less than the projected cost for separate C band and Ku band satellites. Accordingly, no additional financial

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4/ Currently pending before the Commission is a request to locate the Ku band satellite SBS-6 at the 99° location on an interim basis. File No. 1841-DSS-MISC-89. If that request is granted, SBS-6 will be able to provide Ku band capacity at the 99° location in advance of launch of Galaxy IV.

information needs to be provided with this application.

E. Public Interest Considerations

HCG's proposed plan to integrate the C and Ku band payloads into a single hybrid satellite results from a combination of customer demands, evolving technical capabilities, and new opportunities created through the acquisition of the Westar IV satellite by HCG and the grant of authority to replace that satellite. As indicated above, HCG currently holds authorizations for both a Ku band satellite and a C band satellite (and replacement) at the 99° orbit location. Both the Ku band satellite and the C band replacement satellite are scheduled to be launched in the next few years. This time frame therefore presents a unique opportunity to launch a hybrid satellite into that location. No new orbital locations are needed and recently developed superior technology can be incorporated into currently authorized satellites to meet customer demands. The grant of this application therefore would serve the public interest.

HCG's customers have begun to require services that can best be provided by hybrid satellites, for example, the need to coordinate Ku band backhauls with C band distribution on the same satellite. Only recently, however, has Hughes Aircraft Company developed technology that enables its C and Ku band payloads to be located on the same satellite without sacrificing full frequency re-use at both bands and without reducing the power levels commonly used on single-band satellites. As a result of this hybrid technology, HCG will be better able to meet its customers' demands into the twenty-first century.

As noted above, the proposed hybrid design results in significant cost savings compared with the launch of two single band satellites. Moreover, the new hybrid design incorporates the latest satellite technology without causing disruption to adjacent satellite operators. Thus, this minor modification will in no way diminish service to the public, but will maintain and enhance it.

This application is fully consistent with prior Commission decisions. The Commission has stated:

> [Commission] policy is to permit design modifications to be made to satellites under construction where, inter alia, no new orbit locations or frequency bands are involved. The purpose of this policy is to allow state-of-the-art technology to be incorporated into the satellites and in-orbit performance optimized.[5]

This application involves no new orbit locations or frequency bands. Instead, it requests an efficient consolidation of two single-band satellite authorizations that has only recently been made possible by new technological advances.

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5 RCA American Communications, Inc., FCC 85-390 (released August 29, 1985); see also Satellite Business Systems, File No. 1532-DSS-MP/L-83 (released August 5, 1985); Two-Degree Spacing Order, 54 Rad. Reg. 2d 577, ¶ 103 (P&F) (1983) (modification applications will be processed separately from satellite processing rounds).

CONCLUSION

For the reasons outlined above, HCG respectfully requests that the Commission authorize the proposed minor modification to its authority to construct, launch and operate Galaxy IV and Galaxy A.

Respectfully submitted,

HUGHES COMMUNICATIONS GALAXY, INC.

By: ______________________________
Eddy W. Hartenstein
Senior Vice President

Date: October 3, 1989

CERTIFICATION AND SIGNATURE

HCG waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests construction and launch and operating authority in accordance with this application. All statements made in the attached exhibits are a material part hereof, and are incorporated herein as if set out in full in this application.

The undersigned certifies individually and for HCG that the statements made in this application are true, complete, and correct to the best of his knowledge and belief, and are made in good faith.

HUGHES COMMUNICATIONS GALAXY, INC.

By: ______________________

Eddy W. Hartenstein
Senior Vice President

Date: October 3, 1989

CERTIFICATION OF PERSON RESPONSIBLE

FOR PREPARING ENGINEERING INFORMATION

SUBMITTED IN THIS APPLICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's Rules, that I have either prepared or reviewed the engineering information submitted in this application, and that it is complete and accurate to the best of my knowledge.

On behalf of HUGHES COMMUNICATIONS GALAXY, INC.

BY: Lawrence N. Chapman

Lawrence N. Chapman
Manager, Network Services

Date: October 3, 1989

RECEIVED
OCT 6 1989
Domestic Facilities Division
Satellite Radio Branch

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

1-DSS- MP/ML-90
2-DSS- MP/ML-90
3-DSS- ML-90

Request of

HUGHES COMMUNICATIONS GALAXY, INC.

for

Minor Modification of its
Authority to Construct, Launch and Operate
a C Band (Galaxy IV) and Ku Band (Galaxy A)
Domestic Communications Satellite

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

In the Matter of the Applications of HUGHES COMMUNICATIONS GALAXY, INC. For Authority to Construct and Launch a Ku Band Domestic Communications Satellite and a C Band Domestic Communications Satellite and to Operate those Satellites in Geostationary Orbit as Part of its Domestic Communications Satellite System	)	File No.

REQUEST FOR MODIFICATION

Hughes Communications Galaxy, Inc. ("HCG") hereby requests minor modification of its current authority to construct, launch, and operate a Ku band domestic communications satellite known as Galaxy A, currently assigned to the 99° West Longitude location, and of its current authority to construct, launch, and operate a C band domestic communications satellite known as Galaxy IV (previously known as Westar IVR), also assigned to 99° W.L.1/

As explained more fully below, the requested modification would combine the existing C and Ku band authorizations into a single hybrid satellite at the 99° location. The new hybrid satellite also will be known as Galaxy IV.

1/ See Hughes Communications Galaxy, Inc., 3 FCC Rcd 6989 (1988).

A. Overview of Modification

The requested modification proposes to use a single, hybrid satellite in lieu of the two single-band satellites that HCG is currently authorized to operate at the 99° location. Unlike certain hybrid spacecraft of the past, the proposed Galaxy IV hybrid, which will use the new Hughes Aircraft HS 601 bus, will provide full frequency reuse at both C and Ku bands, with full power on all transponders, i.e., 16 watts at C band and 50 watts at Ku band. The hybrid design will afford major efficiencies in spacecraft construction, launch and operation and will provide cross-strapping between frequency bands as described below.

This modification request does not seek the assignment of any new orbital locations. Rather, it merely proposes to use a single spacecraft bus at the location at which HCG is currently authorized to operate two separate single-band spacecraft. Nor does it seek any change in HCG's non-common carrier mode of operation. It does seek to incorporate 16 watt C band transponders, as previously applied for[1/], and to make certain other design improvements as detailed below, but these are only slight modifications to the overall design.

The technical specifications of the communications payload of the hybrid satellite are virtually identical to those

1/ Application of Hughes Communications Galaxy, Inc. to increase Galaxy IV (Westar IVR) and Galaxy V (Westar VR) transponder power to 16 watts was filed with the Commission May 11, 1989.

previously authorized or applied for, with some minor changes to reflect design improvements made possible by recent technological advancements and to respond to current customer requirements. Significantly, none of these changes results in any increase in the interference levels generated into adjacent satellite systems. The HS 601 series spacecraft bus to be used for the hybrid satellite is very similar to that authorized for Galaxy A. This new generation spacecraft bus will allow full frequency re-use at both C and Ku bands, with no reduction from the power levels that are now standard on single-band satellites. Thus, the total technical changes to HCG's current authorizations are modest, except for the fact that only a single satellite is now proposed for the 99° location.

HCG's proposed schedule for Galaxy IV calls for a launch by March 1993, which is consistent with HCG's Ku band authorization at 99° but not with the requirement for the C band satellite at that location. Accordingly, HCG requests an extension of its C band launch date until March 1993 but, as explained below, intends to assure continuous C band coverage at 99° by means of the temporary location of another C band satellite at the 99° orbital position.

The modification sought by this request will provide significant benefits to the public. The use of a single hybrid satellite will realize substantial economies in spacecraft construction, launch and insurance costs. In contrast with previously authorized hybrid satellites, these economies can be achieved without any sacrifice in the technical performance or capabilities of the C band and Ku band communications payloads. The modifications described in the request will provide state-of-the-art satellite services to the public at both C band and Ku band and will provide full frequency reuse in each band.

B. General Technical Information

The Hughes Galaxy IV hybrid satellite will consist of C band and Ku band communications payloads collocated on an HS 601 series spacecraft bus. The technical specifications of the communications payloads are similar to those previously authorized by the Commission for Galaxy A and Galaxy IV (Westar IVR). Although the hybrid spacecraft bus is similar to the bus described in the Galaxy A application, converting to a hybrid design requires certain changes to that bus. The description below provides an overall description of the satellite, and highlights the respects in which the payloads are different from those previously authorized. Information not specified in this modification request, such as the adjacent satellite interference analyses, remains the same as that contained in the Galaxy IV and Galaxy A applications.

1. Satellite Operational Characteristics

a. Frequency Plan

Galaxy IV will operate in the C and Ku bands. The radio frequency and polarization plan are shown in Figures 1a and 1b; center frequency and polarization assignments are listed in Tables 1a and 1b.

The frequency and polarization plan for the C band portion of the communications payload is identical to the plan presented in the original Galaxy IV (Westar IVR) application, and consists of 24 active transponder channels, each with a bandwidth of 36 MHz. The Ku band portion of the communications payload contains 24 active transponder channels, consisting of eight wideband (54 MHz bandwidth) channels and 16 narrowband (27 MHz bandwidth) channels. The arrangement of the Ku band channels has been slightly modified from the Galaxy A authorization to better meet customer requirements.

Certain channels within the communications payload are equipped with "cross-strap" switches. These ground-controlled switches allow specific C band uplink channels to be retransmitted through Ku band downlink channels and, conversely, allow specific Ku band uplink channels to be retransmitted through C band downlink channels. The channels equipped with cross-strapping capabilities are listed in Table 2.

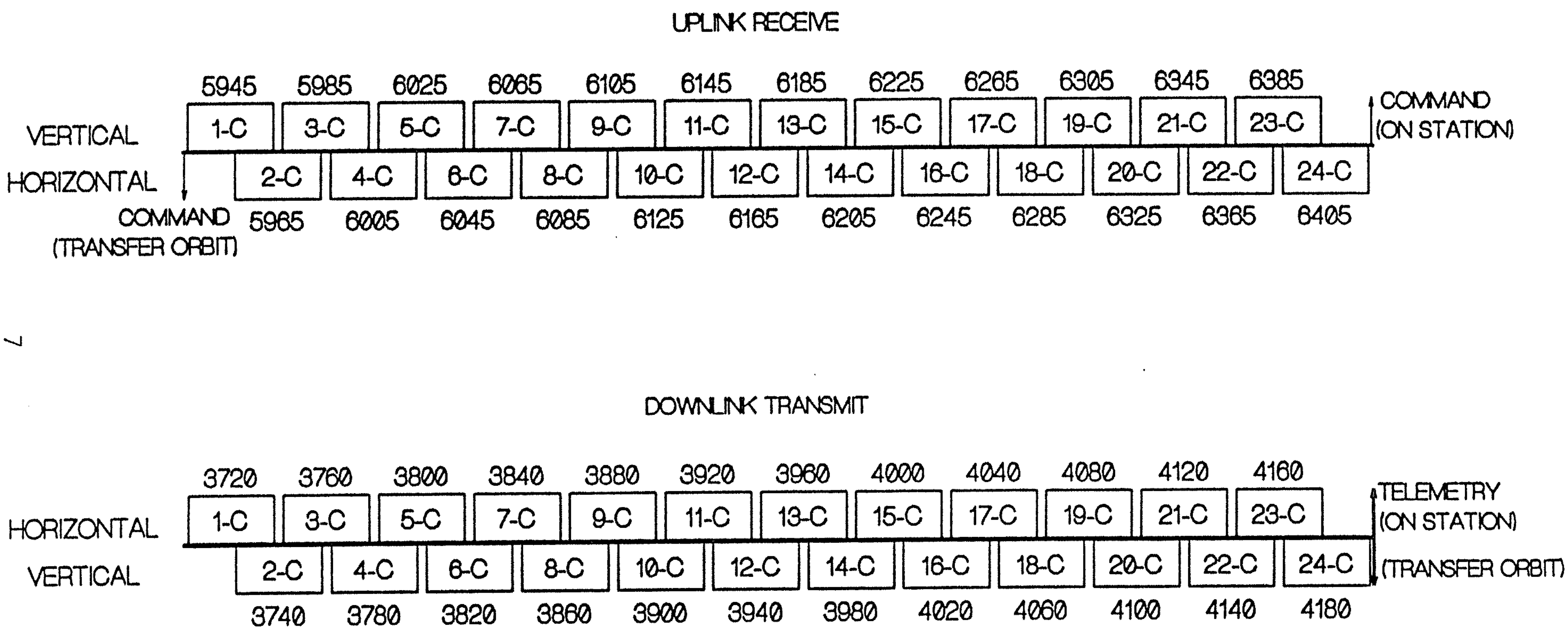


FIGURE 1a. C-Band FREQUENCY AND POLARIZATION PLAN

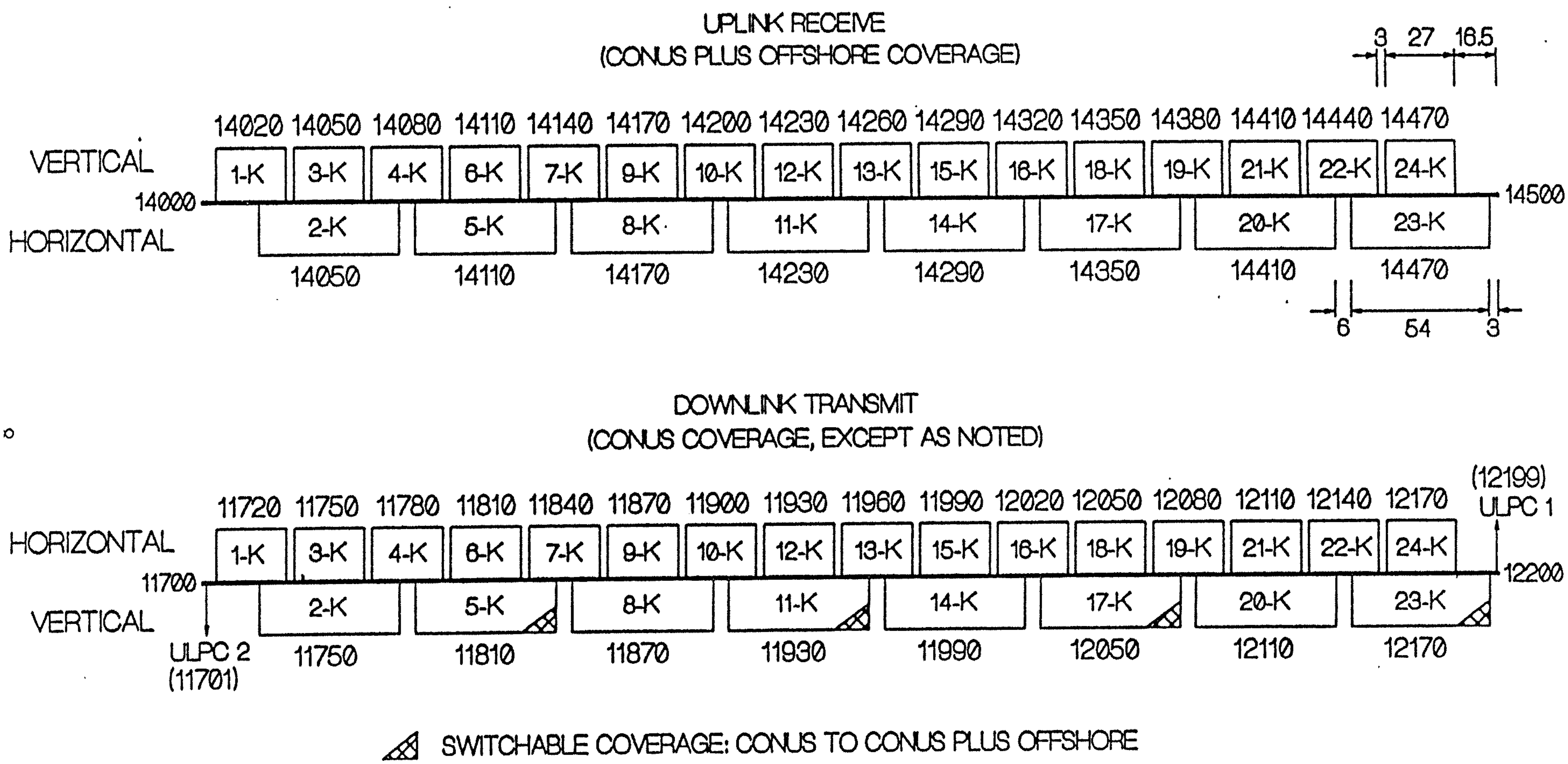


FIGURE 1b. Ku-BAND FREQUENCY AND POLARIZATION PLAN

TABLE 1a

C BAND FREQUENCY AND POLARIZATION ASSIGNMENTS

Channel	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Polarization	Downlink Center Frequency (MHz)	Transponder Bandwidth (MHz)
1	V	5945	H	3720	36
2	H	5965	V	3740	36
3	V	5985	H	3760	36
4	H	6005	V	3780	36
5	V	6025	H	3800	36
6	H	6045	V	3820	36
7	V	6065	H	3840	36
8	H	6085	V	3860	36
9	V	6105	H	3880	36
10	H	6125	V	3900	36
11	V	6145	H	3920	36
12	H	6165	V	3940	36
13	V	6185	H	3960	36
14	H	6205	V	3980	36
15	V	6225	H	4000	36
16	H	6245	V	4020	36
17	V	6265	H	4040	36
18	H	6285	V	4060	36
19	V	6305	H	4080	36
20	H	6325	V	4100	36
21	V	6345	H	4120	36
22	H	6365	V	4140	36
23	V	6385	H	4160	36
24	H	6405	V	4180	36

V = Vertical polarization
H = Horizontal polarization

TABLE 1b

KU BAND FREQUENCY AND POLARIZATION ASSIGNMENTS

Channel	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Polarization	Downlink Center Frequency (MHz)	Transponder Bandwidth (MHz)
1	V	14020	H	11720	27
2	H	14050	V	11750	54
3	V	14050	H	11750	27
4	V	14080	H	11780	27
5	H	14110	V	11810	54
6	V	14110	H	11810	27
7	V	14140	H	11840	27
8	H	14170	V	11870	54
9	V	14170	H	11870	27
10	V	14200	H	11900	27
11	H	14230	V	11930	54
12	V	14230	H	11930	27
13	V	14260	H	11960	27
14	H	14290	V	11990	54
15	V	14290	H	11990	27
16	V	14320	H	12020	27
17	H	14350	V	12050	54
18	V	14350	H	12050	27
19	V	14380	H	12080	27
20	H	14410	V	12110	54
21	V	14410	H	12110	27
22	V	14440	H	12140	27
23	H	14470	V	12170	54
24	V	14470	H	12170	27

V = Vertical polarization
H = Horizontal polarization

TABLE 2

FREQUENCY CROSS-STRAP CHANNELS

Uplink Channel	Downlink Channel Options*
18-C	18-C , 17-K
24-C	24-C , 23-K
17-K	17-K , 18-C
23-K	23-K , 24-C

* Selectable by ground command

In addition to the communications channel frequencies, two C band command uplink, two C band telemetry downlink, and two Ku band downlink beacon frequencies are shown in the plan. During transfer orbit, command signals will be received through a bicone antenna at the higher band-edge frequency. When the satellite is at final orbit position, the primary command uplink will be received at the lower band-edge frequency through the large C band communications reflector, with the bicone link available as a backup. The command uplink will use government-approved command encryption. The two telemetry frequencies shown in the plan will allow simultaneous transmission of two separate or redundant telemetry data streams. The vertically and horizontally polarized downlink beacon signals will be continuously transmitted by the satellite and used by earth station operators as a calibrated reference to compensate for rain attenuation and to adjust antenna pointing.

The satellite communication subsystem will include appropriate filtering at the inputs and outputs of the satellite to minimize internal interchannel interference, noise effects outside the satellite frequency band, and out-of-band spurious transmissions.

b. Emission Designators

Commands to the satellite from the TT&C station will be angle-modulated with a large deviation on the uplink carrier. The satellite will be equipped with government-approved command encryption equipment in order to secure command transmissions.

Telemetry data from the satellite will be angle-modulated on the downlink carrier. The emission designators for the communications, TT&C and downlink beacon signals are as follows:

Signal	Emission Designator
Command	300KF9DXX
Telemetry/Ranging	120KF9DXX
Downlink Beacon	25KONON
Single carrier TV	24M0F3FNN
Dual carrier TV	23M3F8FNF
High Speed Data	25M7G1WDN
Digital (T1) data	1M17G1WDF
Digital voice	24K3G1WDF
Digital (64 kbps) data	48K6G1WDF
FM Audio (Narrowband)	50K0F3EJF
FM Audio (Wideband)	150KF3EJF

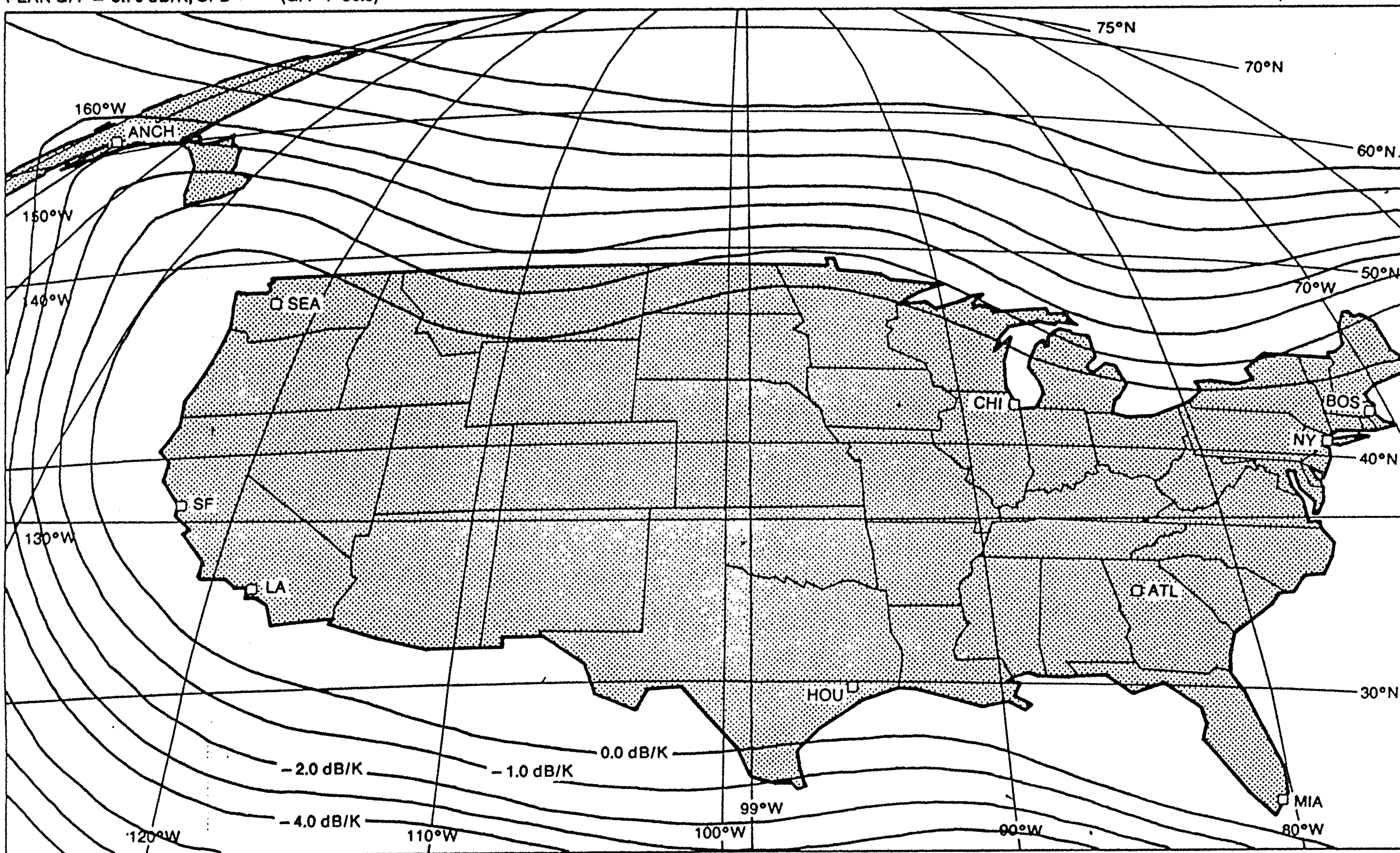
c. <u>Communications Coverage</u>

The C band communications coverage pattern is essentially identical to the pattern specified in the Galaxy IV (Westar IVR) application. The C band receive and transmit patterns provide shaped beam coverage of the contiguous United States ("CONUS"), Alaska, Hawaii, Puerto Rico, and U.S. Virgin Islands. Representative C band receive gain-to-noise temperature ratio ("G/T") and Effective Isotropic Radiated Power ("EIRP") contours are shown in Figures 2a through 2d. Values for Saturation Flux Density ("SFD") for C band communications may be calculated by using the equations specified at the top of Figures 2a and 2b.

The receive pattern for Ku band communications provides coverage over CONUS, Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands. The Ku band transmit pattern provides CONUS coverage for all Ku band downlinks. In addition, the transmit beams of four specific Ku band channels can be switched into "Offshore" mode. In Offshore mode, CONUS coverage is expanded to include Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands. Representative Ku band G/T and EIRP contours are shown in Figures 3a through 3e. Satellite SFD may be calculated for Ku band communications by using the equations specified at the top of Figures 3a and 3b.

HUGHES

PEAK G/T = 5.70 dB/K, SFD = – (G/T + 86.5)

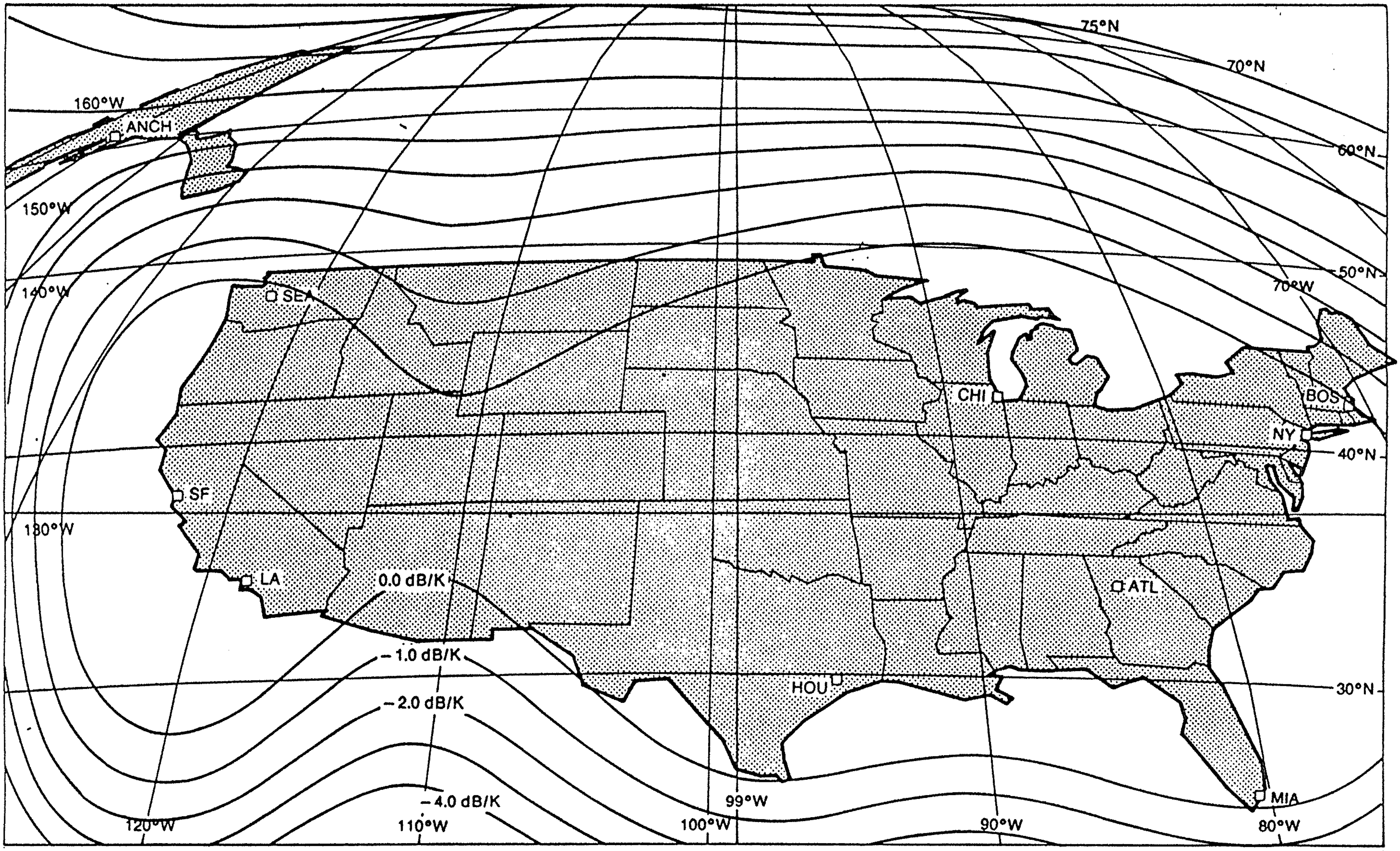


COMMANDABLE STEP ATTEN 4 dB

FIGURE 2a. C-BAND G/T COVERAGE (HORIZONTAL RECEIVE)

HC 890512
19 SEPT 89

PEAK G/T = 3.73 dB/K, SFD = − (G/T + 86.5)



COMMANDABLE STEP ATTEN 4 dB

FIGURE 2b. C-BAND G/T COVERAGE (VERTICAL RECEIVE)

HC 890511
19 SEPT 89

PEAK EIRP = 41.15 dBW

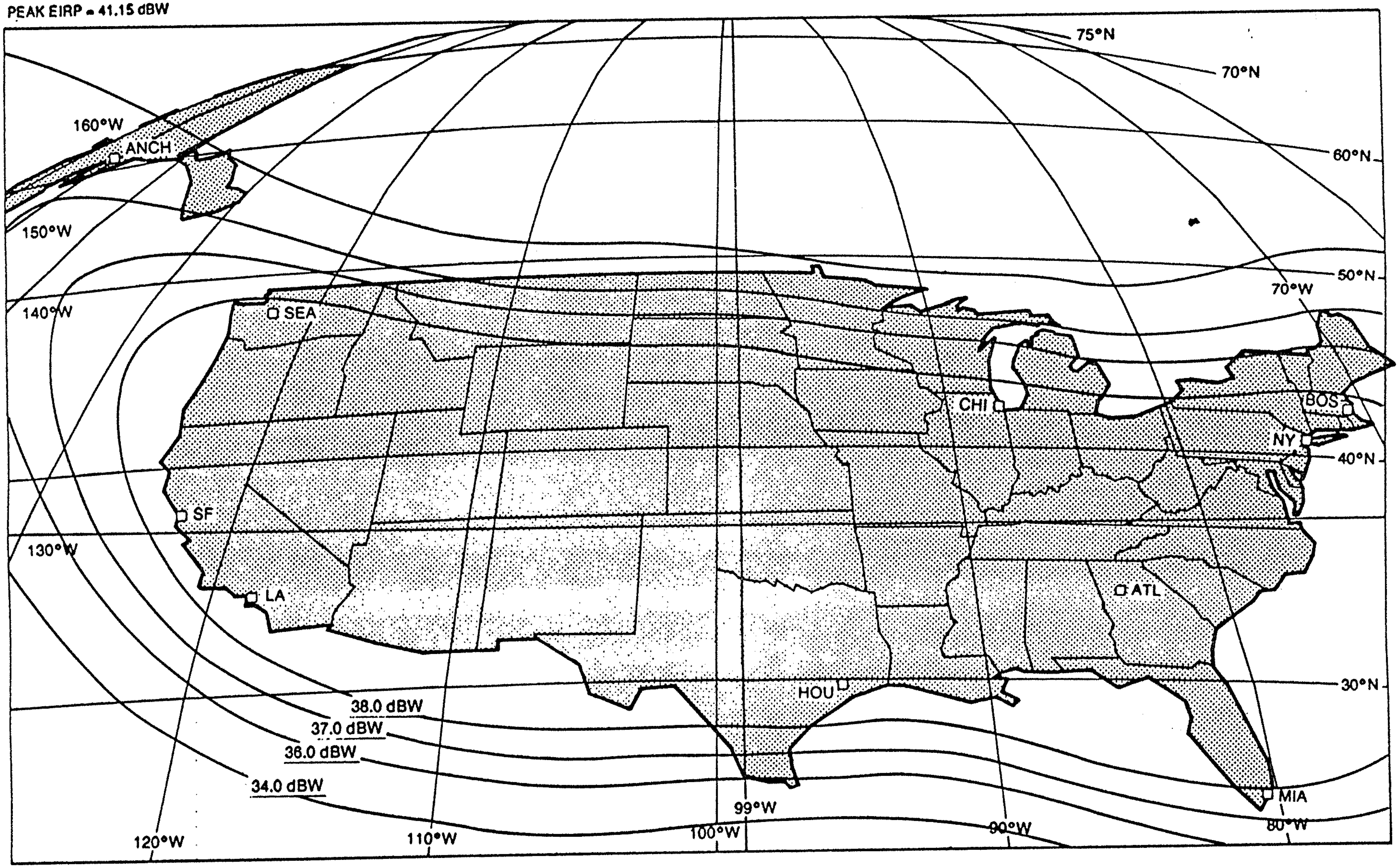


FIGURE 2c. C-BAND EIRP COVERAGE (HORIZONTAL TRANSMIT)

HC 890509
19 SEPT 89

HUGHES

PEAK EIRP = 40.51 dBW

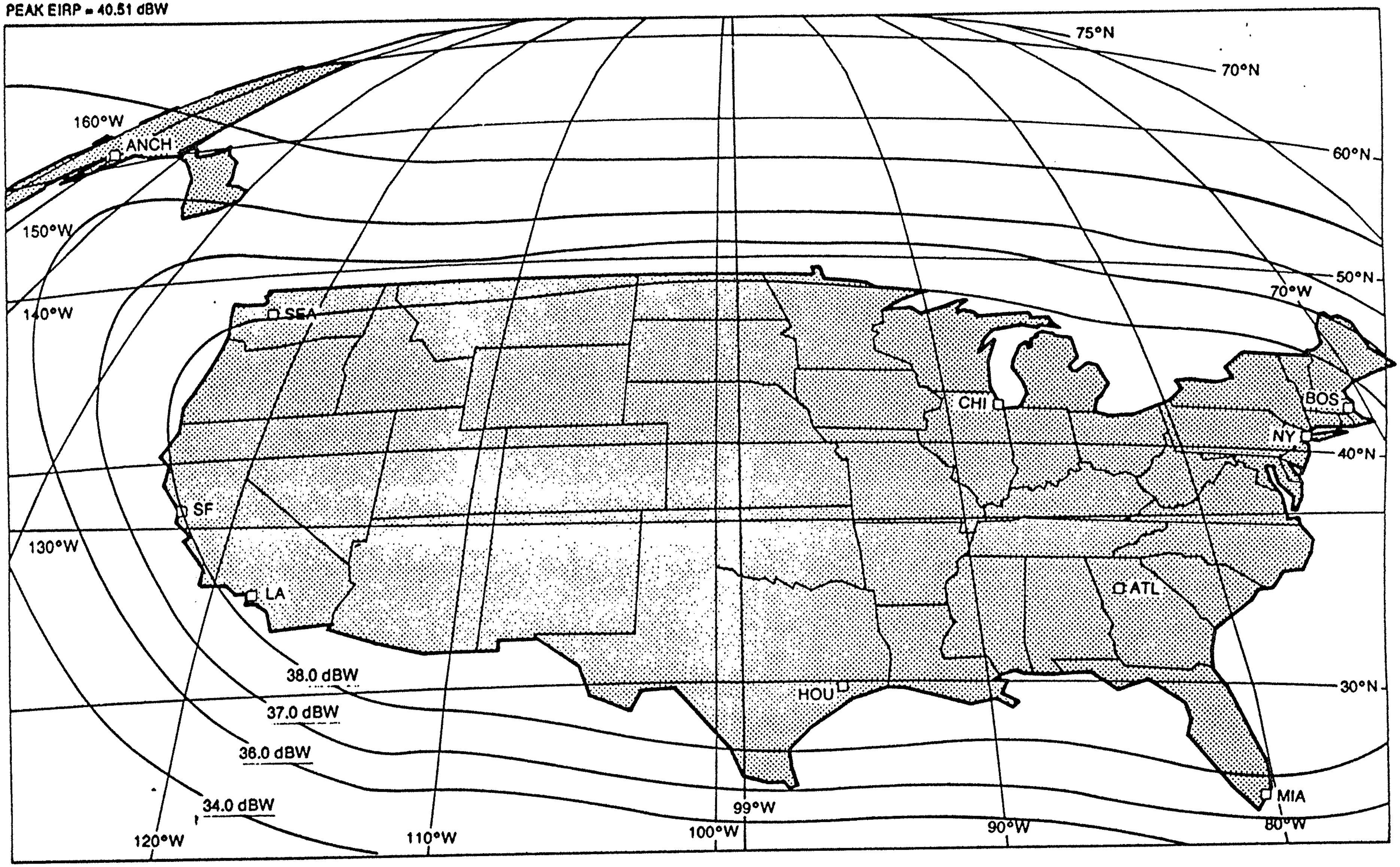
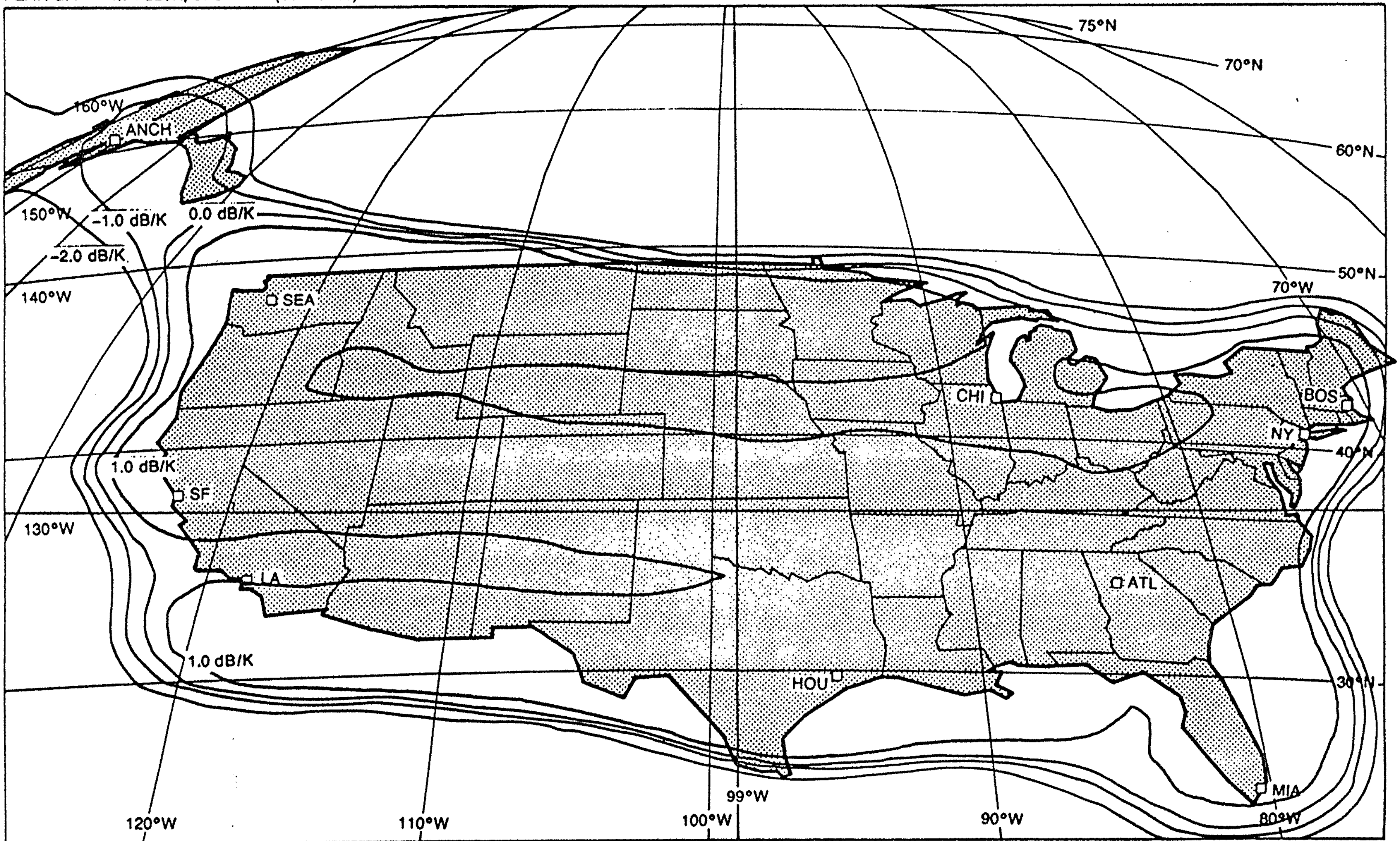


FIGURE 2d. C-BAND EIRP COVERAGE (VERTICAL TRANSMIT)

HC 890510
19 SEPT 89

HUGHES

PEAK G/T = 4.74 dB/K, SFD = − (G/T + 86)



COMMANDABLE STEP ATTEN 4 dB

FIGURE 3a. Ku-BAND G/T COVERAGE (HORIZONTAL RECEIVE)

HC 890502
19 SEPT 89

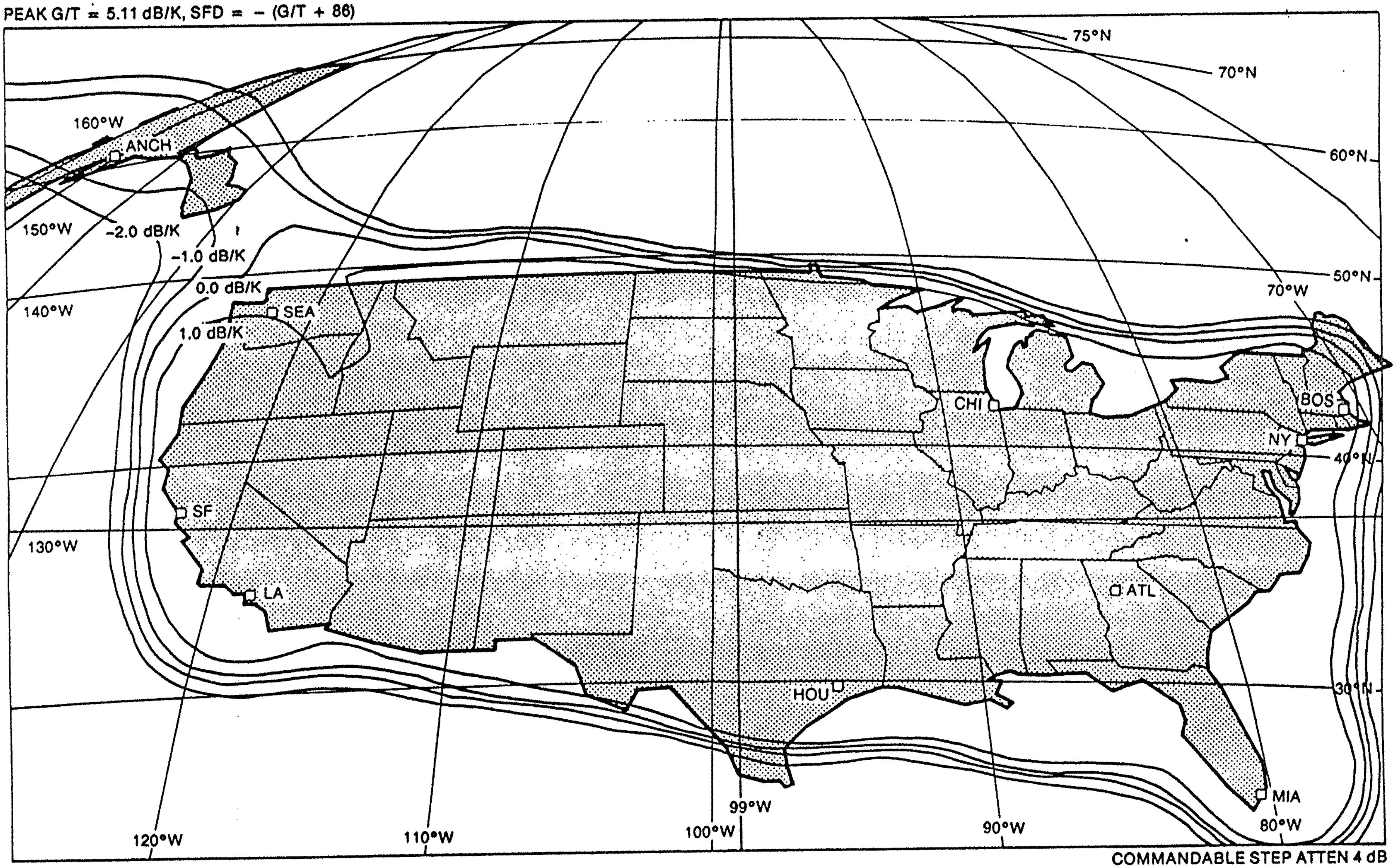


FIGURE 3b. Ku-BAND G/T COVERAGE (VERTICAL RECEIVE)

HC 890501
19 SEPT 89

HUGHES

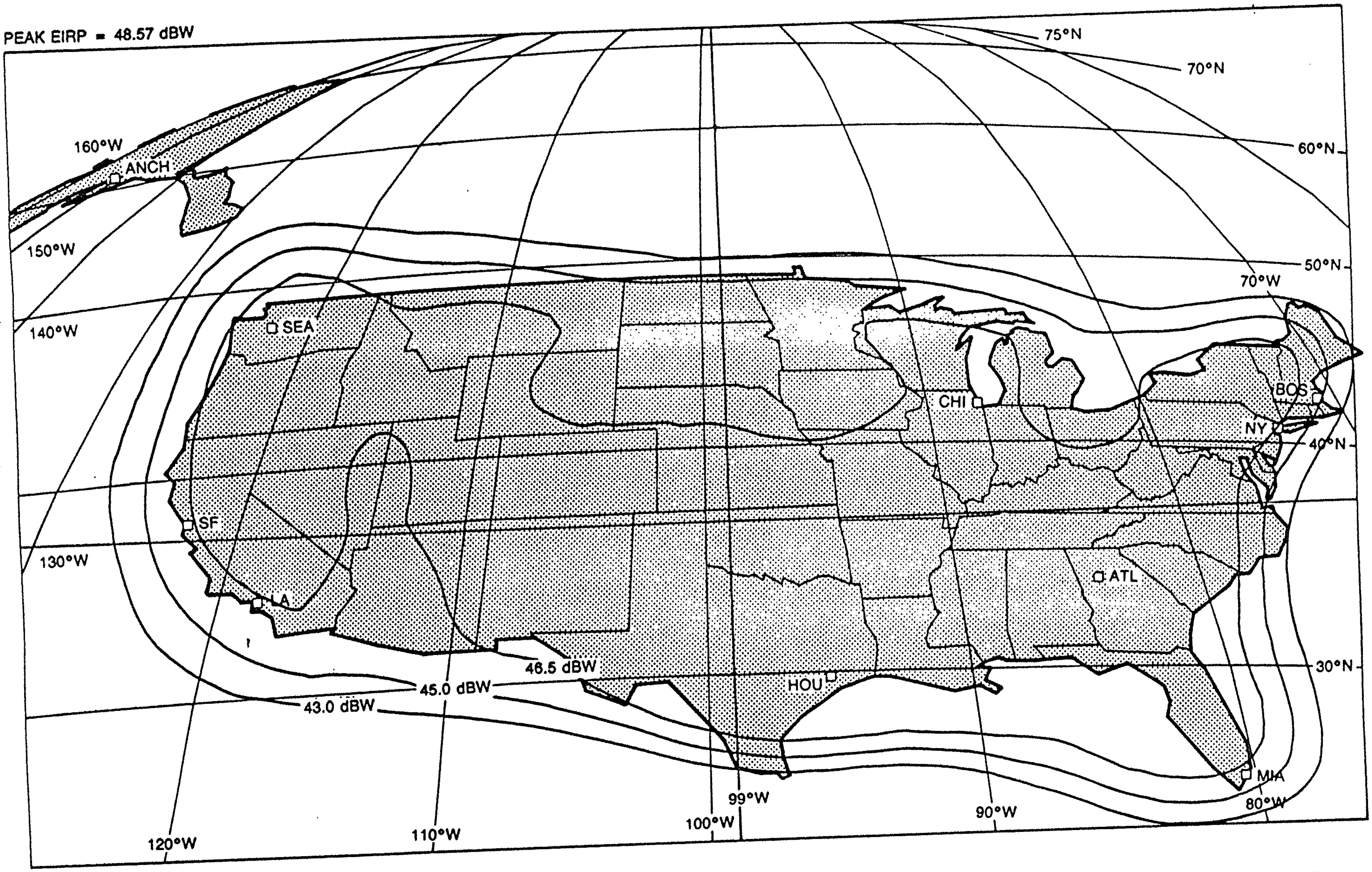


FIGURE 3c. Ku-BAND EIRP COVERAGE (HORIZONTAL TRANSMIT, CONUS ONLY)

HC 890504
19 SEPT 89

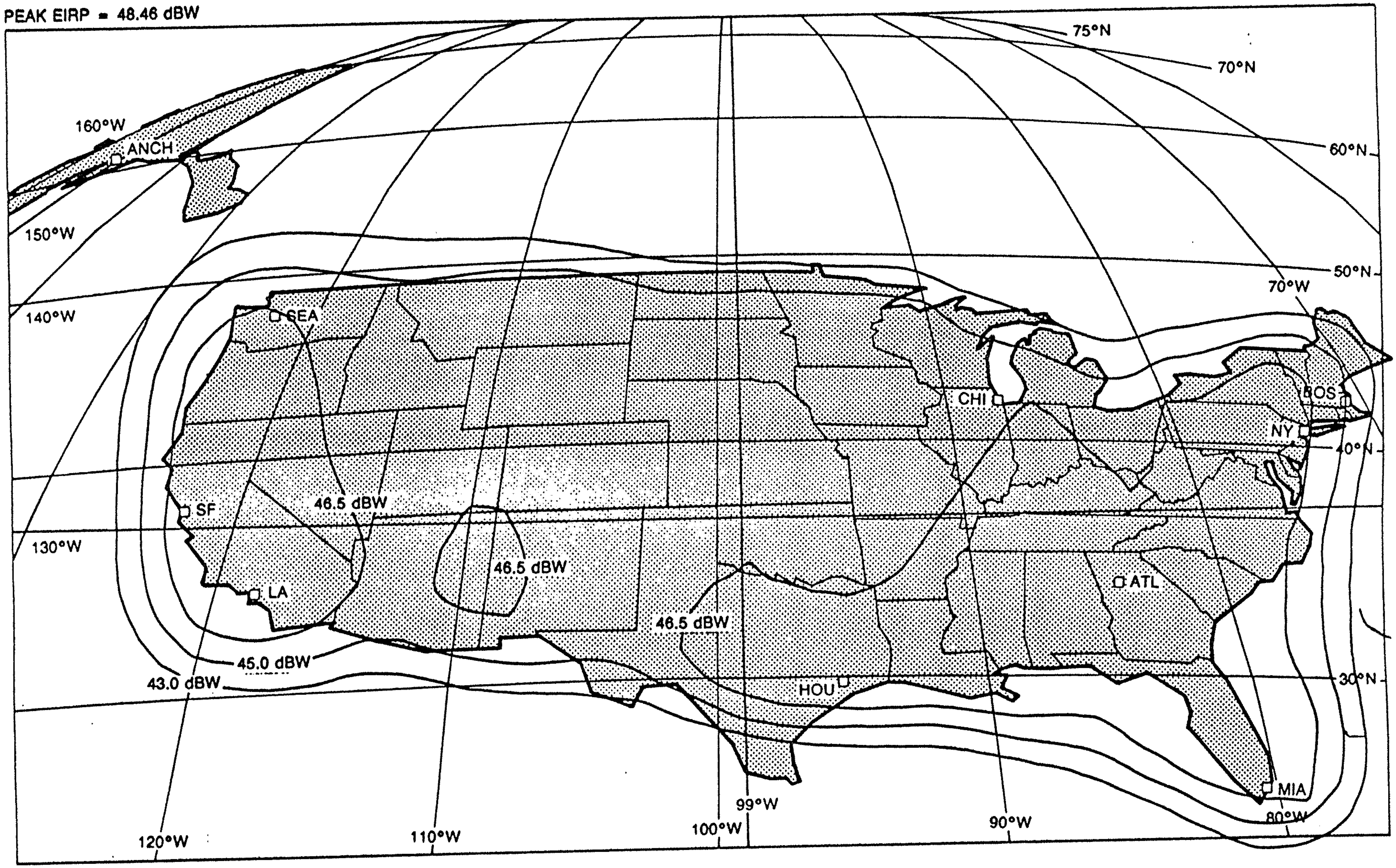


FIGURE 3d. Ku-BAND EIRP COVERAGE (VERTICAL TRANSMIT, CONUS ONLY)

HC 890505
19 SEPT 89

HUGHES

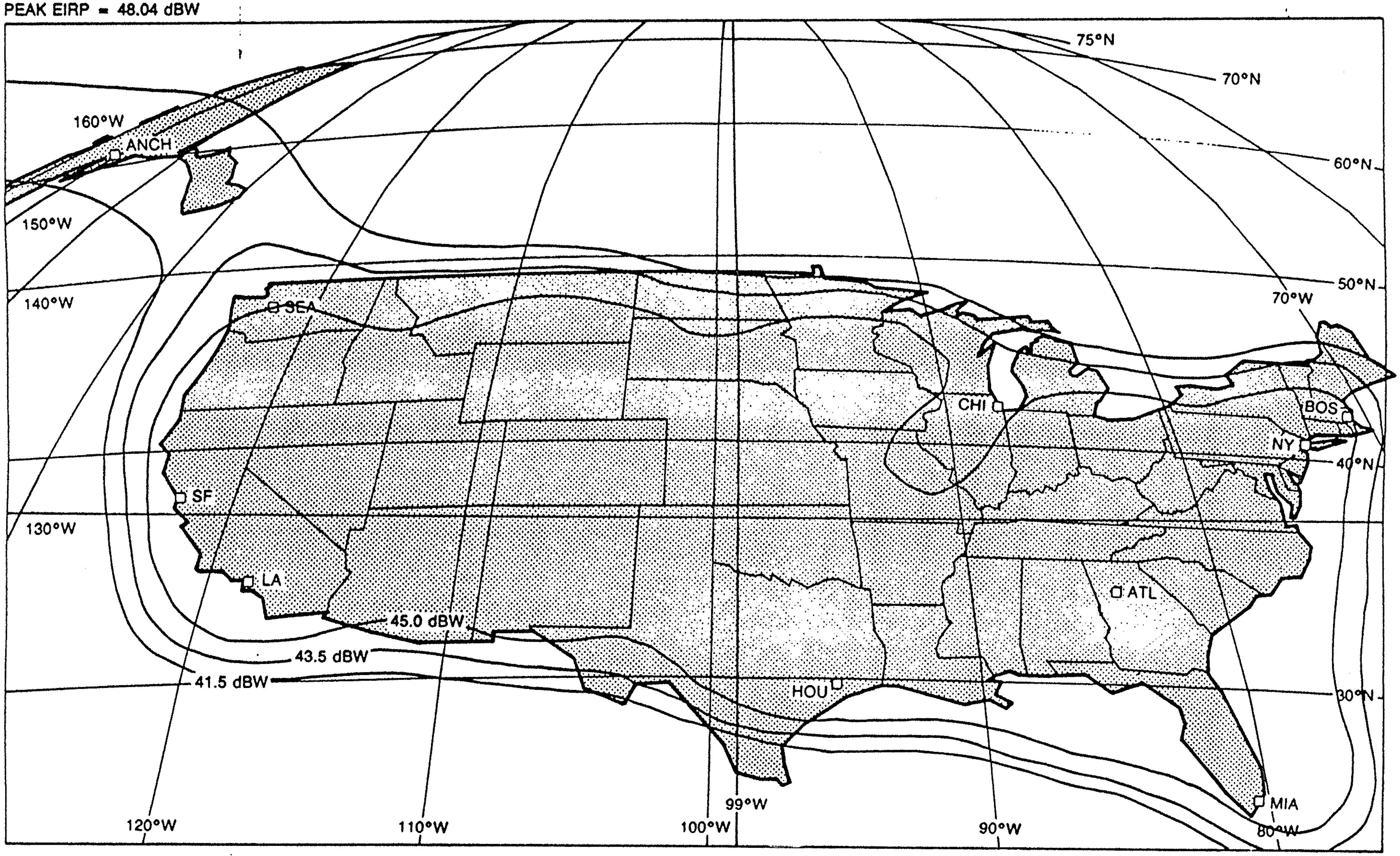


FIGURE 3e. Ku-BAND EIRP COVERAGE (VERTICAL TRANSMIT, CONUS & OFFSHORE)

HC 890503
19 SEPT 89

2. Satellite Characteristics

The on-orbit configuration of the satellite is illustrated in Figure 4. Major spacecraft characteristics are summarized in Table 3.

a. Spacecraft Bus

The HS 601 series spacecraft bus used for Galaxy IV is fundamentally the same as the bus described in the Galaxy A application. The weight and power generation capabilities of the spacecraft have been increased in response to the larger communications payload. The weight and power budget estimates presented in Tables 4 and 5 are based upon a mission life of 12 years.

TABLE 3

SPACECRAFT CHARACTERISTICS

General	
Spacecraft bus	Hughes, HS 601
Launch vehicle	Ariane, Titan, STS, Atlas
Stabilization	
Transfer orbit	Spin stabilized
On station	Body stabilized
Mission life	12 years
Design life	15 years
Eclipse capability	100 percent (48 channels)
Stationkeeping	
North-South (orbital inclination)	±0.05 degrees
East-West (longitudinal drift)	±0.05 degrees
Antenna pointing	
East-West North-South	±0.14 degrees azimuth ±0.14 degrees elevation
Beam rotation (antenna axis attitude)	±0.25 degrees

TABLE 3 (cont'd.)

Communications	C Band	Ku Band
Frequency		
Receive	5925-6425 MHz	14000-14500 MHz
Transmit	3700-4200 MHz	11700-12200 MHz
Polarization	Hor/Ver Linear	Hor/Ver Linear
Number of transponders	24	24
Transponder bandwidth	36 MHz	27 MHz (16 ch.) 54 MHz (8 ch.)
Receive G/T (CONUS)	-1.0 dB/K	2.0 dB/K
Transponder gain (@ 0dB attenuator step)	112 dB	114.6 dB
Receive Saturation Flux Density (CONUS)	-90 to -76 dBW/M^2 (2 dB increments)	-92 to -72 dBW/M^2 (2 dB increments)
Transmit EIRP (CONUS)	38 dBW	45 dBW
Transmitter RF power	16 Watts	50 Watts
Transmitter redundancy	30 for 24	30 for 24

Emission limitations (percentage of authorized bandwidth)	
50 to 100%	>25 dB attenuation in any 4 kHz
100 to 250%	>35 dB attenuation in any 4 kHz
Greater than 250%	>61 dB attenuation in any 4 kHz

Table 3 (cont'd.)

Tracking, Telemetry and Command		
Frequency		
Command, Ranging and Tracking Beacon	5925 to 5930 MHz transfer orbit 6420 to 6425 MHz on station	
Telemetry and Ranging	2 signals within 4198 to 4200 MHz	
Polarization	Transfer Orbit	On Station
Command, Ranging	Horizontal, linear	Vertical, linear
Telemetry, Ranging	Vertical, linear	Horizontal, linear
Bandwidth		
Command, Ranging	300 kHz	
Telemetry/Ranging	120 kHz	
Telemetry EIRP		
Transfer Orbit	10.0 dBW maximum	
On Station	15.9 dBW maximum	
Command Threshold (flux density)		
Transfer Orbit	-91.0 dBW/m^2	
On Station	-105.0 dBW/m^2	

TABLE 4
WEIGHT BUDGET

Category	Weight, lbs.
Communications subsystem weight	560
Bus weight	1,980
Estimated spacecraft dry weight	2,540
Margin	90
Maximum allowable dry weight (Ariane IV, shared)	2,630
Fuel, expendables	2,875
Total launch weight	5,505

TABLE 5
POWER BUDGET

Category	Power, Watts
Communications subsystem power	3,437
Bus power	341
Total Power Requirement	3,778
End-of-Life array capability (12 years)	4,133
End-of-Life Margin	355

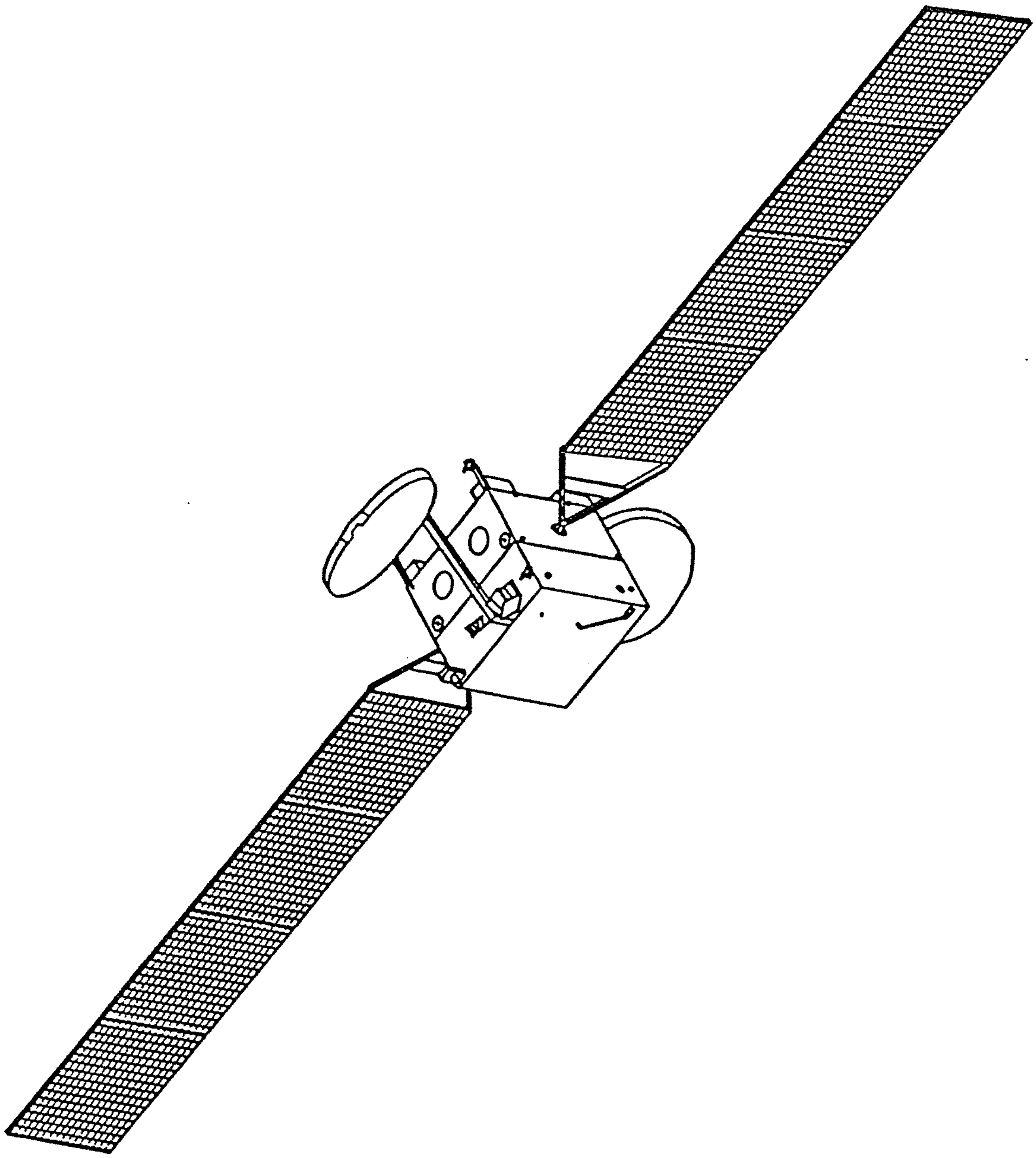


FIGURE 4. GALAXY IV ON-ORBIT CONFIGURATION

b. Antenna Subsystem

The satellite antenna subsystem contains two parabolic reflectors each consisting of two polarization-selective gridded offset paraboloids sharing the same aperture. One of these reflectors is used for C band communications; the other reflector is used for Ku band communications. The four multihorn feed assemblies which feed the reflectors are frequency diplexed to allow each assembly to be used for transmit and receive functions.

c. Communications Subsystem

The communications subsystem consists of two communications repeaters: a 24 channel C band repeater employing 16 watt solid state power amplifiers (SSPA's), and a 24 channel Ku band repeater employing 50 watt traveling wave tube amplifiers (TWTA's). Except for the limited frequency cross-strapping capabilities previously described, the C band and Ku band repeaters are essentially independent of each other. A functional block diagram of the C band and Ku band repeaters is presented in Figure 5.

Except for the modifications listed below and the rearrangement of the Ku band channel plan previously described, the key features and characteristics of the C band and Ku band repeater designs are the same as those described in the original applications. The only significant changes made to the C band repeater are (1) the replacement of the 4-step, 3-dB increment commandable step attenuator with an 8-step, 2-dB increment step attenuator, and (2) the use of ring redundancy for the SSPA's instead of a channel-bank redundancy scheme. The modified step attenuator provides greater operational flexibility for each transponder channel. Use of ring redundancy greatly enhances the overall availability and reliability of the C band communications channels.

The only significant changes made to the Ku band repeater are (1) the reduction of the TWTA RF power from 60 watts to 50 watts, and (2) the elimination of the Variable Power Dividers which followed the TWTA (this device was used to switch to half-CONUS mode, which is no longer a feature of the Ku band repeater).

None of the above modifications results in an increase of the potential interference level into adjacent satellite systems. In fact, the modifications to the Ku band payload actually decrease that payload's interference potential. No further interference analysis is therefore necessitated by these changes.2/

2/ In connection with the joint request of Satellite Transponder Leasing Corporation (STLC") and HCG to locate SBS-6 at the 99° location on a temporary basis, see File No. 8141-DSS-MISC-89, Contel ASC and AT&T each filed comments that raised certain concerns about coordinating their satellites with Galaxy A at 99°. In their Joint Reply Comments (filed September 20, 1989) HCG and STLC explained how those concerns could be readily resolved. HCG's solution is unaffected by this modification.

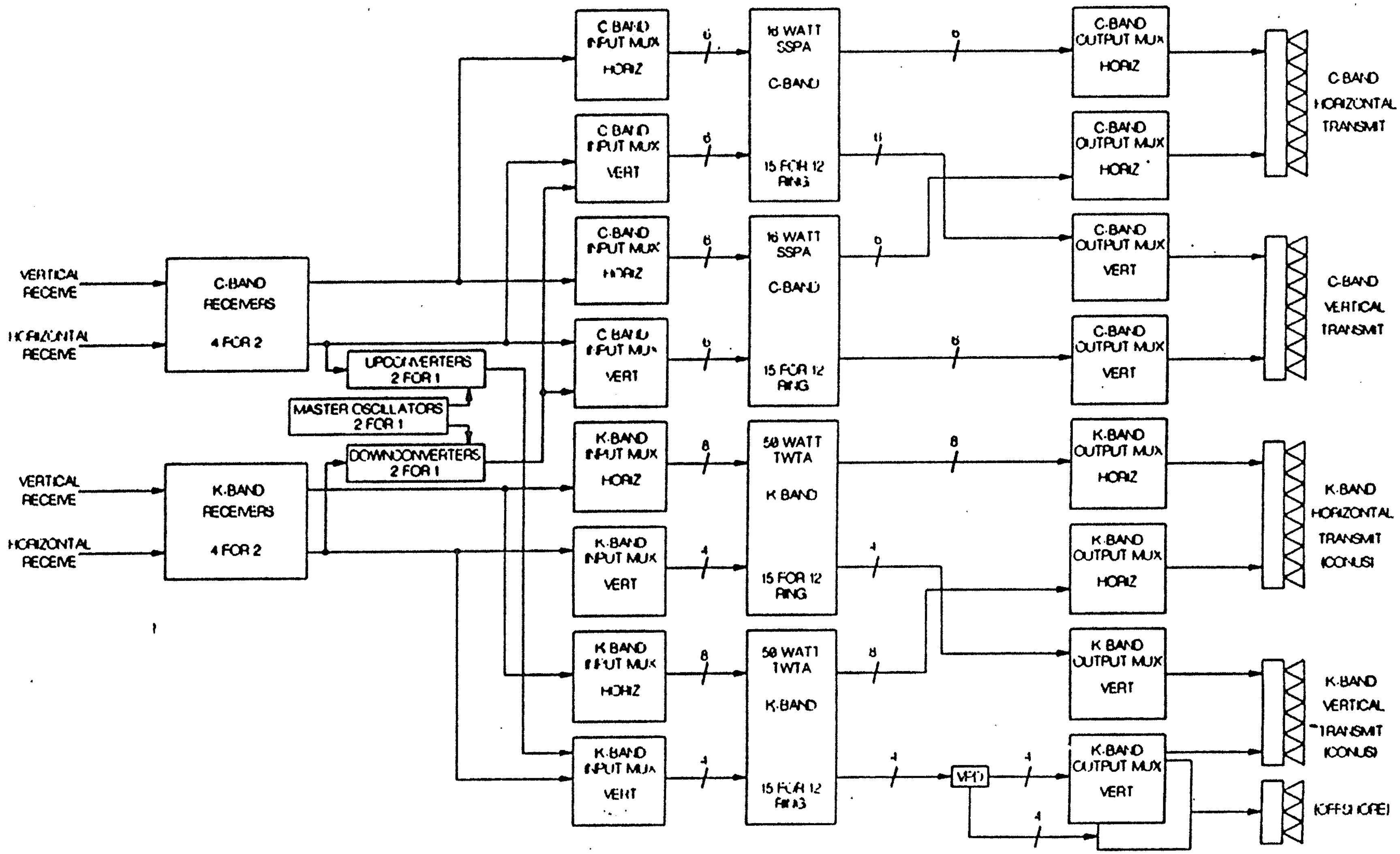


FIGURE 5. REPEATER BLOCK DIAGRAM

d. Telemetry, Tracking and Command ("TT&C")

The TT&C subsystem to be used in the hybrid satellite is substantially equivalent to the TT&C subsystem described in the Galaxy IV (Westar IVR) application. The only major difference between the hybrid's TT&C subsystem and Westar IVR's subsystem is the elimination of the beacon tracking function within the command/track receiver. Beacon tracking was deemed to be unnecessary since the attitude control performance of the satellite using earth sensor references was determined to satisfy the $\pm$ 0.14° (E-W, N-S) antenna pointing objective. The TT&C subsystem major parameters have been summarized in Table 3.

e. Satellite Useful Lifetime

The design lifetime of the satellite in orbit (excluding fuel limitations) is 15 years. This has been determined by a conservative evaluation of the effect of the synchronous orbit environment on the solar array, the effect of the charge-discharge cycling on the life of the batteries, and the wearout of the TWTAs. The mass allocation of propellant for spacecraft stationkeeping is 12 years. To enhance the probability of survival, spacecraft equipment will be redundant wherever possible. Materials and processes will be selected so that aging or wearing effects will not adversely affect spacecraft performance over the estimated life.

f. Satellite Stationkeeping

Inclination of the satellite orbit will be maintained to ±0.05 degree or less, and the satellite will be maintained to within ±0.05 degree of the nominal longitude position. Attitude of the satellite will be maintained to an accuracy consistent with the achievement of the specified communications performance, after taking into account all error sources (e.g., attitude perturbations, thermal distortions, misalignments, orbital tolerances, and thruster perturbations).

In addition to the propellant required for operational attitude and orbital control, extra propellant will be incorporated to provide correction of the initial orbit and initial attitude acquisition. Sufficient propellant will be included in the satellite to permit a 12-year operational life.

C. Schedule

Hughes Aircraft Company has already begun construction of certain aspects of the C band and Ku band communications payloads that previously have been authorized, as well as the HS 601 satellite bus authorized for Galaxy A. By separate letter filed today, HCG is requesting a Section 319(d) waiver to permit it to commence construction of the modified design immediately, at its own risk. HCG intends to launch Galaxy IV in March 1993. This date is consistent with HCG's current Ku band launch milestone[3/], but represents an extension of its C band launch milestone, which is May 1991. An extension of the C band launch date is required in order to accommodate the change in design and the need to launch both payloads of a hybrid satellite at the same time. Accordingly, HCG respectfully requests an extension

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3/ Galaxy A is required to be launched by July 1993.

of its C band milestone dates regarding launch and operation.

HCG's current C band satellite at the 99° location, Westar IV, is expected to reach its end-of-life in mid-1991. Notwithstanding the gap between the end-of-life of Westar IV and the launch of Galaxy IV, HCG is committed to provide continuous service to its C band customers at 99°. HCG is currently exploring a variety of options to provide this interim capacity. One of the options involves locating one of HCG's C band satellites at the 99° location (upon Commission approval) on an interim basis from the end-of-life of Westar IV until the launch of the Galaxy IV hybrid.[4/] In addition, HCG is currently exploring the possible use of other spacecraft, outside the Galaxy fleet, for interim C band capacity at 99° W.L. In any event, HCG will take whatever steps are necessary, including necessary filings with the Commission, to ensure that there is no lapse in C band coverage at 99° due to the time needed to construct and launch the hybrid.

D. Satellite Costs

HCG's financial qualifications to construct, launch, and operate Galaxy IV (Westar IVR) and Galaxy A have already been demonstrated. The projected cost for the Galaxy IV hybrid satellite is less than the projected cost for separate C band and Ku band satellites. Accordingly, no additional financial

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4/ Currently pending before the Commission is a request to locate the Ku band satellite SBS-6 at the 99° location on an interim basis. File No. 1841-DSS-MISC-89. If that request is granted, SBS-6 will be able to provide Ku band capacity at the 99° location in advance of launch of Galaxy IV.

information needs to be provided with this application.

E. Public Interest Considerations

HCG's proposed plan to integrate the C and Ku band payloads into a single hybrid satellite results from a combination of customer demands, evolving technical capabilities, and new opportunities created through the acquisition of the Westar IV satellite by HCG and the grant of authority to replace that satellite. As indicated above, HCG currently holds authorizations for both a Ku band satellite and a C band satellite (and replacement) at the 99° orbit location. Both the Ku band satellite and the C band replacement satellite are scheduled to be launched in the next few years. This time frame therefore presents a unique opportunity to launch a hybrid satellite into that location. No new orbital locations are needed and recently developed superior technology can be incorporated into currently authorized satellites to meet customer demands. The grant of this application therefore would serve the public interest.

HCG's customers have begun to require services that can best be provided by hybrid satellites, for example, the need to coordinate Ku band backhauls with C band distribution on the same satellite. Only recently, however, has Hughes Aircraft Company developed technology that enables its C and Ku band payloads to be located on the same satellite without sacrificing full frequency re-use at both bands and without reducing the power levels commonly used on single-band satellites. As a result of this hybrid technology, HCG will be better able to meet its customers' demands into the twenty-first century.

As noted above, the proposed hybrid design results in significant cost savings compared with the launch of two single band satellites. Moreover, the new hybrid design incorporates the latest satellite technology without causing disruption to adjacent satellite operators. Thus, this minor modification will in no way diminish service to the public, but will maintain and enhance it.

This application is fully consistent with prior Commission decisions. The Commission has stated:

> [Commission] policy is to permit design modifications to be made to satellites under construction where, inter alia, no new orbit locations or frequency bands are involved. The purpose of this policy is to allow state-of-the-art technology to be incorporated into the satellites and in-orbit performance optimized.[5]

This application involves no new orbit locations or frequency bands. Instead, it requests an efficient consolidation of two single-band satellite authorizations that has only recently been made possible by new technological advances.

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5 RCA American Communications, Inc., FCC 85-390 (released August 29, 1985); see also Satellite Business Systems, File No. 1532-DSS-MP/L-83 (released August 5, 1985); Two-Degree Spacing Order, 54 Rad. Reg. 2d 577, ¶ 103 (P&F) (1983) (modification applications will be processed separately from satellite processing rounds).

CONCLUSION

For the reasons outlined above, HCG respectfully requests that the Commission authorize the proposed minor modification to its authority to construct, launch and operate Galaxy IV and Galaxy A.

Respectfully submitted,

HUGHES COMMUNICATIONS GALAXY, INC.

By: ______________________________
Eddy W. Hartenstein
Senior Vice President

Date: October 3, 1989

CERTIFICATION AND SIGNATURE

HCG waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests construction and launch and operating authority in accordance with this application. All statements made in the attached exhibits are a material part hereof, and are incorporated herein as if set out in full in this application.

The undersigned certifies individually and for HCG that the statements made in this application are true, complete, and correct to the best of his knowledge and belief, and are made in good faith.

HUGHES COMMUNICATIONS GALAXY, INC.

By: [signature]

Eddy W. Hartenstein
Senior Vice President

Date: October 3, 1989

CERTIFICATION OF PERSON RESPONSIBLE
FOR PREPARING ENGINEERING INFORMATION
SUBMITTED IN THIS APPLICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's Rules, that I have either prepared or reviewed the engineering information submitted in this application, and that it is complete and accurate to the best of my knowledge.

On behalf of HUGHES COMMUNICATIONS GALAXY, INC.

BY: Lawrence N. Chapman

Lawrence N. Chapman
Manager, Network Services

Date: October 3, 1989