EXHIBIT 1 of FCC FORM 422 Question 5C, 6, 10

The following describes:

(a) The complete program of research and experimentation proposed including description of equipment and theory of operation.
(b) The specific objectives to be accomplished.
(c) How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion or utilization of the radio art, or is along lines not already investigated.

1.0 Introduction

Both the commercial airlines and the government have expressed a need for two-way, broadband, high data rate, satellite communications with mobile aeronautical platforms. In addition to television reception, two-way broadband satellite services would provide passengers and crew with constant access to information via data services, e-mail, and internet web access using laptop computers. Extending broadband data services to mobile aeronautical platforms would improve business, government, and airlines efficiency.

ARINC proposes to employ the Ku band fixed satellite service (FSS) to achieve a two-way, broadband, high data rate, satellite communications system for mobile aeronautical platforms. Of presently fielded satellite systems, the Ku band FSS offers the radiated power and bandwidth to achieve high data rates. In the ARINC system, the Technical Operations Center (TOC)-to-satellite and mobile units-to-satellite links comprise the “uplinks” while the satellite-to-mobile units and satellite-to-TOC links comprise the “downlinks.” The uplink band is allocated as “Primary” for the Fixed Satellite Service (FSS) with a “Secondary” allocation to Mobile-Satellite Services, with an exclusion of aeronautical mobile-satellite service. The downlink band is also allocated as Primary for the FSS with no provision for mobile-satellite services. Because the ARINC system does not fall into any of the allocated services in these bands, a waiver from the FCC must be obtained to use Ku-Band satellite service in the United States. A condition of any such waiver is that the ARINC system must not cause, and must accept, interference to/from stations licensed in the Primary and Secondary Services. . Because ARINC will lease transponders from an existing (“FSS”) operator, the two downlinks present no real licensing issues, assuming that the FCC will allow the links to be used for mobile-satellite service. The TOC-to-satellite and satellite-to-TOC links will use GE Americomm’s teleport facility in Woodbine, Maryland.

The regulatory environment under which the ARINC system will operate is primarily governed by Title 47 (Telecommunications), Part 25 (Satellite Communications) of the Code of Federal Regulations (“CFR”), and by the International Telecommunication Union (“ITU”) Regulations, Appendix S8 (formerly Appendix 29). The ARINC system will use currently available antenna technology coupled with spread spectrum methods, and TOC control, to enable the aircraft to satellite uplink to operate below the ITU/FCC interference thresholds. Two important precedents have already been set which serve to support licensing for the ARINC system. First, Qualcomm, Inc. ("Qualcomm") was granted blanket authority to construct and operate a 12/14 GHz network of up to 20,600 mobile and transportable earth stations and a fixed hub station. Second, the Boeing Company ("Boeing") was granted an experimental license, valid through August 1, 2001, under Part 5 of Title 47 CFR. This license was issued for transmitting mobile platforms throughout CONUS at 14.0-14.5 GHz.

2.0 Objective

The object of this experiment is to develop a broadband, high data rate, satellite communication system for transmission from mobile aeronautical platforms that meets the interference requirements of the Ku band fixed satellite service (FSS).

3.0 Approach

The ARINC experimental system will implement the two-way broadband satellite communications system shown in Figure 1, between the Airborne and Ground systems.

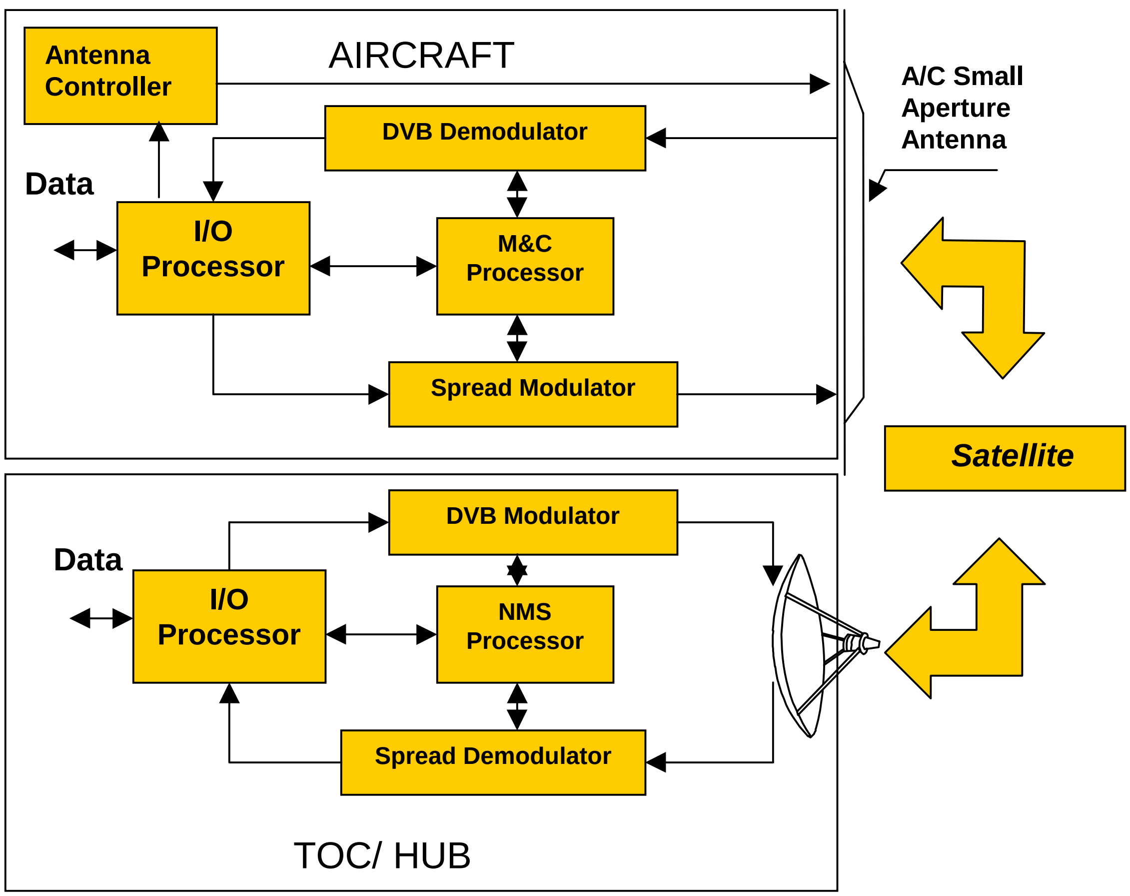

Figure 1. Two - Way Broadband Satellite System

3.1 Forward Link

The forward link (ground-to-aircraft) provides the satellite connection from the Technical Operations Center (TOC) to the aircraft. It is a high-rate broadcast transmission that is fully compliant with the Digital Video Broadcasting–Satellite (DVB-S) transmission standard ETS 300 421. This international standard provides predictable performance and a mature, well-characterized transmission format. The forward link will allow any of the ETS 300 421 supported Forward Error Correction (FEC) coding options to be employed. The basic characteristics of the DVB-S standard broadcast are:

- Modulation: QPSK
- Roll-off Factor: 0.35
- Outer FEC Code: Reed Solomon(204, 188, 8)
- Inner FEC Code: 1/2, 2/3, 3/4, 5/6, 7/8

The forward link data rate is scalable from 4 Mbps to 10 Mbps of video and data. Also the TOC's Network Management System (NMS) uses the forward Uplink to control the return link. This includes the authorization to transmit, and control of frequency, transmit power, and data rate to manage adjacent satellite interference and provide bandwidth on demand.

3.2 Return Link

The return link (aircraft-to-ground) provides the satellite connection from the aircraft to the TOC. The return link design uses spread spectrum techniques to mitigate interference to adjacent satellites and to enable multiple aircraft to simultaneously access the satellite. In the transceiver, the DVB receiver card demodulates and decodes the forward channel signal and provides video and data to the I/O processor, and control data to the Monitor and Control Processor (M&C). The M&C processor implements the network management functions acting as the airborne agent for the TOC NMS. The I/O processor formats the data for interface to the Ethernet LAN and delivery to the aircraft server. The I/O Processor also receives IP packets from the server and formats them for delivery to the modulator card. The modulator card generates the spread waveform for transmitting the packets to the TOC. The I/O processor also receives ARINC 429 bus data from the server and passes it to the antenna control function. ARINC will use a single satellite transponder for the experimental system. Use of a single transponder will limit the return link transmission rates from each airborne platform to roughly 256 Kbps, with an aggregate return link capacity from all aircraft simultaneously of approximately 8 Mbps.

The return channel waveform includes the following key features:

- Random-access packet system
- Spread-spectrum, multiple-access
- A constant envelope spreading sequence modulation (GMSK)
- Use of short block length Turbo codes
- Flexible chip rates (bandwidth) and data rates

- Ability of the NMS to control the flow rate of the return-channel traffic on an individual aircraft basis or at a network level.

The return channel NMS will monitor the aggregate return channel signal to ensure that mutual interference levels among the individual transmissions remain at an acceptable level. The data rate of individual return channel transmissions can be flexibly assigned to control throughput for the aggregate network and/or individual aircraft and operate below the ITU/FCC interference thresholds. Supported return-channel burst information rates are: 32Kbps, 64 Kbps, 128 Kbps, 256 Kbps, and 512 Kbps. The network can be operated with a mix of return-channel data rates, allowing each aircraft to achieve the level of throughput appropriate for demand.

3.3 Aircraft Antenna

The airborne antenna system will use a broadband aperture to operate over the full frequency range of the Ku-band Fixed Satellite Service (FSS), 11.7 – 12.2 GHz for receive and 14.0 – 14.5 GHz for transmit.. It will simultaneously transmit and receive through one Ku-band satellite using any of the transponders leased on that satellite, and can be steered to operate on any FSS Ku-band satellite selected for operations. The antenna design enables seamless growth of the system to meet increased demand and expanded airline services through both the addition of transponders and the addition of satellites.

Performance characteristics of the on-board antenna system support bi-directional broadband communications and meet the FCC's interference requirements for mobile use. Specific capabilities of the antenna include:

- Pointing and/or tracking error does not exceed 0.25 degrees with a 3D tracking rate of 30 degrees per second. This provides sufficient accuracy to meet satellite link performance and adjacent satellite interference requirements with functional accuracy throughout the typical commercial aviation aircraft maneuver envelope.
- Polarization adjustment provides a linear phase match with the satellite transponder throughout the flight route of the aircraft. This mitigates cross-polarization and co-polarization interference.
- G/T receive figure of merit is no less than10.0 dB/K and the transmit EIRP is no less than 40 dBW throughout the operating bandwidth and over the full beam steering range.
- Beam steering range is 360° in azimuth and 80° in elevation starting at 10° above the horizon and extending to the 90° zenith.
- Beamwidth is less than 1.75° X 7.5°.
- Sidelobe level gain conforms to the envelope defined in 47 CFR 25.209(a)(1) [Antenna performance standards]. Figure 2. shows the transmit antenna pattern at Phi Cuts of 0°,37.25°,45°, and 90° with respect to the 29-25 log (θ) envelope for main beam offset angles from 1° to 7°. The tapered aperture maintains a good peak sidelobe level for phi cuts to 60°, satisfactory for the maximum sidelobe level generated along the geostationary satellite orbit (GSO) by aircraft in the CONUS. The 90° cut shows the sidelobe level generated only by aircraft near the equator.

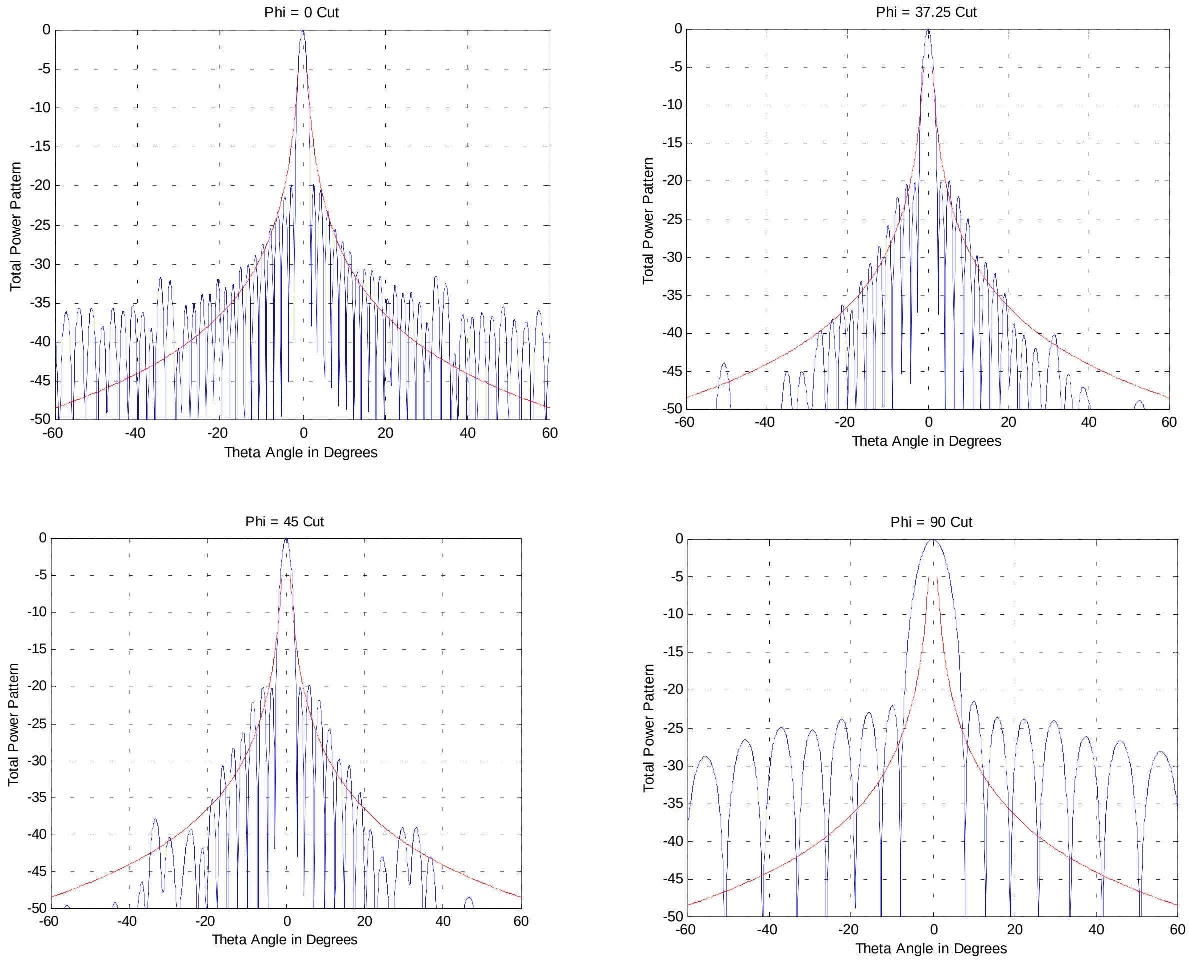

Figure 2. Transmit Antenna Pattern at 0°,37.25°,45°, and 90° Degrees

3.4 Return Link Budget

The Table 1, return uplink budget (Aircraft to Satellite), shows the experimental case for 36 mobile platforms each operating at 256Kbps with a spreading bandwidth of 34.2 MHz via the GE-6 satellite. The aggregate power spectral density of the mobile platforms is -19.1 dBW/4 kHz, which is 5.1 dB below the -14 dBW/4 kHz licensing threshold required for VSAT terminals by Title 47 CFR 25.134. The Table 2, return downlink budget (Satellite to Earth Station), shows that the experimental case for 36 mobile platforms will achieve a margin of 1.4 dB Eb/No with 16 dB of satellite backoff.

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3.5 Return Link ΔT/T Interference Analysis

ITU Appendix S8 (Formerly Appendix 29) states that the ratio of the increase in link noise temperature to the equivalent satellite link noise temperature for the system cannot exceed the $\Delta T/T$ threshold value of 6%. If the ARINC system remains at or below the threshold value, coordination with adjacent satellite providers is not required for licensing. If the ARINC system exceeds the threshold value, licensing approval will not be given until coordination is made with all adjacent satellite providers for whom the threshold value is exceeded. The Return Link $\Delta T/T$ Interference Analysis of Table 3 shows the $\Delta T/T$ is 4%, 2% below the threshold value. The Return Link Copolarized Channel $\Delta T/T$ Interference Analysis of Table 4 shows the $\Delta T/T$ is 3.1%, 2.9% below the threshold value.

4. Summary

Granting of an experimental license will enable ARINC to develop a two-way, broadband, high data rate, satellite communications system for aeronautical mobile satellite service (AMSS). The ARINC system would extend to aircraft passengers and aircrews broadband data services including live television, e-mail, and internet two-way web access. Extending broadband data services to mobile aeronautical platforms would bring new services to an underserved portion of the American public and serve to improve business, government, and airlines efficiency.

The technical characteristics of ARINC's proposed AMSS system will enable the system to operate on a non-conforming, non-interference basis in full compliance with ITU/FCC interference protection rules.

Granting this experimental license would be in the public interest.

Table 1. Return Link: Aircraft to Satellite

parameter	*unit*	*value*
Satellite		**GE 6**
Frequencies		
uplink frequency	**GHz**	**14.3**
uplink wavelength	**m**	**0.0210**
downlink frequency	**GHz**	**12.2**
downlink wavelength	**m**	**0.0246**
Antenna characteristics		
aircraft receive antenna G/T	**dB/K**	**10.0**
aircraft system temperature	**K**	**150.0**
	dBK	**21.8**
aircraft receive antenna gain	**dB**	**33.0**
aircraft transmit antenna gain	**dB**	**33.0**
satellite antenna G/T (EOC)	**dB/K**	**1.2**
satellite system temperature	**K**	**600**
	dBK	**27.8**
satellite receive antenna gain (EOC)	**dB**	**29.0**
Radiated power		
channels per aircraft		**1**
	dB	**0.0**
number of aircraft		**36**
total number of channels		**36**
	dB	**15.6**
power into antenna per channel	**W**	**3.00**
	dBW	**4.8**
total power into all antennas	**W**	**108.0**
	dBW	**20.3**
spreading bandwidth	**MHz**	**34.2**
	dBHz	**75.3**
FCC reference bandwidth	**kHz**	**4.0**
system power spectral density	**dBW/4 kHz**	**-19.0**
maximum allowable aggregate power spectral density	**dBW/4 kHz**	**-14.0**
C/No		
EIRP per channel	**dBW**	**37.8**
radome loss	**dB**	**0.5**
slant range	**km**	**39000**
free space loss	**dB**	**207.4**
aircraft antenna pointing error	**deg**	**0.25**
azimuth HPBW	**deg**	**1.75**
azimuth tracking loss	**dB**	**0.24**
polarization misalignment angle	**deg**	**5.0**
polarization loss	**dB**	**0.0**
rain loss	**dB**	**0.0**
received power per channel	**dBW**	**-141.4**
Boltzmann's constant	**dBW/KHz**	**-228.6**
thermal noise density (uplink)	**dBW/Hz**	**-200.8**
number of CDMA interferers within system	**dB**	**15.4**
total CDMA interfering power	**dBW**	**-126.0**
CDMA interfering power density	**dBW/Hz**	**-201.3**
total noise density (uplink)	**dBW/Hz**	**-198.0**
C/No (uplink)	**dBHz**	**56.6**

Table 2. Return Link: Satellite to Earth Station

parameter	*unit*	*value*
satellite		GE 6
satellite W longitude	deg	81.0
Satellite EIRP per channel		
EIRP per channel	dBW	37.8
number of channels		36.0
	dB	15.6
total EIRP	dBW	53.3
slant range	km	39000
$4 \pi d^2$	dBm^2	162.8
flux density	dBW/m^2	-109.5
saturation flux density	dBW/m^2	-90.0
input backoff	dB	19.5
output backoff	dB	16.0
maximum satellite EIRP (Woodbine)	dBW	51.0
satellite total EIRP (Woodbine)	dBW	35.0
satellite EIRP per channel (Woodbine)	dBW	19.5
C/No		
frequency	GHz	12.2
wavelength	m	0.025
satellite EIRP per channel	dBW	19.5
earth station antenna diameter	m	9.0
earth station antenna efficiency	fraction	0.60
earth station antenna gain	dB	59.0
earth station system temperature	K	125.0
	dBK	21.0
earth station antenna G/T	dB/K	38.0
slant range	km	39000
free space loss	dB	206.0
rain loss	dB	0.0
received power per channel	dBW	-127.5
Boltzmann's constant	dBW/KHz	-228.6
thermal noise density (downlink)	dBW/Hz	-207.6
thermal noise density (uplink)	dBW/Hz	-200.8
number of CDMA interferers within system	dB	15.4
total CDMA interfering power	dBW	-112.1
spreading bandwidth	dBHz	75.3
CDMA interfering power density	dBW/Hz	-187.4
total noise density (downlink)	dBW/Hz	-187.2
C/No (downlink)	dBHz	59.7
Available Eb/No		
information bit rate	kbps	256
information bit rate	dBHz	54.1
Eb/No (available)	dB	5.6
Required Eb/No		
BER		1.0E-08
turbo code		(PCCC)
turbo code		(PCCC)
Eb/No (ideal)	dB	3.0
implementation loss	dB	1.2
Eb/No (required)	dB	4.2
margin	dB	1.4

Table 3. Return Link: $\Delta T/T$ Interference Analysis

parameter	*unit*	*value*
Satellite		**GE 6**
Frequencies		
uplink frequency	GHz	14.3
uplink wavelength	m	0.0210
downlink frequency	GHz	12.2
downlink wavelength	m	0.0246
Antenna characteristics		
aircraft receive antenna G/T	dB/K	10.0
aircraft system temperature	K	150.0
	dBK	21.8
aircraft receive antenna gain	dB	33.0
aircraft transmit antenna gain	dB	33.0
satellite antenna G/T (EOC)	dB/K	1.2
satellite system temperature	K	600
	dBK	27.8
satellite receive antenna gain (EOC)	dB	29.0
Radiated power		
channels per aircraft		1
	dB	0.0
number of aircraft		36
total number of channels		36
	dB	15.6
power into antenna per channel	W	3.00
	dBW	4.8
total power into all antennas	W	108.0
	dBW	20.3
spreading bandwidth	MHz	34.2
	dBHz	75.3
FCC reference bandwidth	kHz	4.0
system power spectral density	dBW/4 kHz	-19.0
maximum allowable aggregate power spectral density	dBW/4 kHz	-14.0
C/No		
EIRP per channel	dBW	37.8
radome loss	dB	0.5
slant range	km	39000
free space loss	dB	207.4
aircraft antenna pointing error	deg	0.25
azimuth HPBW	deg	1.75
azimuth tracking loss	dB	0.24
polarization misalignment angle	deg	5.0
polarization loss	dB	0.0
rain loss	dB	0.0
received power per channel	dBW	-141.4
Boltzmann's constant	dBW/KHz	-228.6
thermal noise density (uplink)	dBW/Hz	-200.8
number of CDMA interferers within system	dB	15.4
total CDMA interfering power	dBW	-126.0
CDMA interfering power density	dBW/Hz	-201.3
total noise density (uplink)	dBW/Hz	-198.0
C/No (uplink)	dBHz	56.6

Table 3 (continued). ΔT/T Interference Analysis

operating satellite		GE 6
adjacent satellite		
Link gain		
adjacent satellite saturation flux density	dBW/m^2	-92.0
adjacent satellite receive antenna gain	dB	31.0
area of an isotropic receiver (uplink)	dBm^2	-44.6
uplink received power	dBW	-105.6
adjacent satellite EIRP	dBW	48.0
adjacent satellite earth station antenna diameter	m	3.0
adjacent satellite earth station maximum receive antenna gain	dB	49.1
slant range	km	39000
free space loss	dB	206.0
downlink received power	dBW	-108.9
link gain γ	dB	-3.4
	numeric	0.462
Interference		
ΔT (total)	K	25.9
T (total)	K	712.0
$\Delta T/T$	numeric	0.036
	percent	3.6
maximum allowable $\Delta T/T$	percent	6.0

Table 4. Return Link: Copolarized Channel ΔT/T Interference Analysis

parameter	***unit***	***value***
operating satellite		**GE 6**
Radiated power		
uplink frequency	**GHz**	**14.3**
wavelength	**m**	**0.0210**
channels per aircraft		**1**
	dB	**0.0**
number of aircraft		**36**
total number of channels		**36**
	dB	**15.6**
power into antenna per channel	**W**	**3.00**
	dBW	**4.8**
total power into all antennas	**dBW**	**20.3**
spreading bandwidth	**MHz**	**34.2**
	dBHz	**75.3**
FCC reference bandwidth	**kHz**	**4.0**
total power spectral density into all antennas	**dBW/4 kHz**	**-19.0**
Uplink copolarized channel interference to same satellite		
aircraft transmit maximum antenna gain	**dB**	**33.0**
EIRP per channel	**dBW**	**37.8**
radome loss	**dB**	**0.5**
satellite maximum receive antenna gain	**dB**	**31.0**
slant range	**km**	**39000**
free space loss	**dB**	**207.4**
polarization misalignment angle	**deg**	**5**
copolarization channel polarization loss	**dB**	**21.2**
bandwidth ratio	**dB**	**3.5**
interfering power per channel	**dBW**	**-163.8**
total interfering power	**dBW**	**-148.2**
Boltzmann's constant	**dBW/K Hz**	**-228.6**
spreading bandwidth	**MHz**	**34.2**
	dBHz	**75.3**
ΔT (uplink)	**dBK**	**5.0**
	K	**3.2**
adjacent satellite maximum G/T	**dB/K**	**1.0**
adjacent satellite system temperature	**dBK**	**30.0**
	K	**1000.0**
$\Delta T/T$	**numeric**	**0.003**
	percent	**0.3**
maximum allowable $\Delta T/T$	**percent**	**6.0**